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W3C, XML Schema. Disponível em: <<http://www.w3.org/XML/Schema>>. Acesso em: 07 agosto 2004 (b).

W3C, Extensible Markup Language – XML. Disponível em: <<http://www.w3.org/XML/>>. Acesso em: 07 de agosto 2004 (c).

W3C, XML Pipeline Definition Language, Disponível em: <http://www.w3.org/TR/xml-pipeline/>. Acesso em: 08 agosto 2004 (d).

Wroe, C. et al. A Suite of DAM+OIL Ontologies to Describe Bioinformatics Web services and Data, International Journal of Cooperative Information Systems, v. 12, n. 2, 2003.

Anexo 1 – Definição da Ontologia

Este anexo apresenta duas ontologias de processos de Bioinformática. A primeira, escrita em OWL, modela os processos, contêineres, conexões e projetos como instâncias em OWL, e os programas de análise, tipos de dados de entrada e saída e tipos de recursos como classes em OWL. A segunda, escrita em Amzi-Prolog, modela basicamente uma taxonomia de tipos de programas de análise, dados de entrada e saída e recursos, acrescida de propriedades e relacionamentos entre estes objetos.

Ontologia em OWL

```
<?xml version="1.0"?>
<rdf:RDF
  xmlns:rss="http://purl.org/rss/1.0/"
  xmlns:jms="http://jena.hpl.hp.com/2003/08/jms#"
  xmlns:protege="http://protege.stanford.edu/plugins/owl/protege#"
  xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
  xmlns:rdfs="http://www.w3.org/2000/01/rdf-schema#"
  xmlns="http://www.puc-rio.br/melissa/Bio#"
  xmlns:owl="http://www.w3.org/2002/07/owl#"
```

```
xmlns:vcard="http://www.w3.org/2001/vcard-rdf/3.0#"
xmlns:daml="http://www.daml.org/2001/03/daml+oil#"
xmlns:dc="http://purl.org/dc/elements/1.1/"
xml:base="http://www.puc-rio.br/melissa/Bio">
<owl:Ontology rdf:about="">
<owl:Class rdf:ID="Project">
<rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string">
    Modela um projeto de Bioinformatica.
</rdfs:comment>
</owl:Class>

<owl:Class rdf:ID="Complete">
<rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string">
    Modela um projeto para sequenciamento completo do genoma de um organismo.
</rdfs:comment>
<rdfs:subClassOf rdf:resource="#Project"/>
</owl:Class>

<owl:Class rdf:ID="EST">
<rdfs:subClassOf>
    <owl:Class rdf:about="#Project"/>
</rdfs:subClassOf>
<rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string">
```

Modela um projeto cujo objetivo e obter somente as sequencias codificantes.

</rdfs:comment>

</owl:Class>

<owl:Class rdf:ID="Workflow">

<rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string">

Modela uma composicao de processos, modelando chamadas a programas de Bioinformatica que analisam biossequencias e que ajudam um pesquisador a interpreta-las.

</rdfs:comment>

</owl:Class>

<owl:ObjectProperty rdf:ID="Process_Used">

<rdfs:range rdf:resource="#Process"/>

<rdfs:domain rdf:resource="#Workflow"/>

<rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string">

Relaciona um workflow a um processo.

</rdfs:comment>

</owl:ObjectProperty>

<owl:ObjectProperty rdf:ID="Container_Used">

<rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string">

Relaciona um workflow a uma contêiner.

</rdfs:comment>

```
<rdfs:range rdf:resource="#Container"/>
<rdfs:domain rdf:resource="#Workflow"/>
</owl:ObjectProperty>
```

```
<owl:ObjectProperty rdf:ID="Connection_Used">
  <rdfs:range rdf:resource="#Connection"/>
  <rdfs:domain rdf:resource="#Workflow"/>
  <rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string">
    Relaciona um workflow a uma conexao.
  </rdfs:comment>
</owl:ObjectProperty>
```

```
<owl:Class rdf:ID="Process">
  <rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string">
    Modela uma chamada a um programa de Bioinformatica.
  </rdfs:comment>
</owl:Class>
```

```
<owl:Class rdf:ID="Filter">
  <rdfs:subClassOf>
    <owl:Class rdf:about="#Process"/>
  </rdfs:subClassOf>
  <rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string">
```

Um filtro analisa um conjunto de dados gerado por um processo e extrai partes dele para futuro processamento.

```
</rdfs:comment>
```

```
</owl:Class>
```

```
<owl:Class rdf:ID="Constructive">
```

```
<rdfs:subClassOf>
```

```
<owl:Class rdf:about="#Process"/>
```

```
</rdfs:subClassOf>
```

```
<rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string">
```

Um processo construtivo cria novos conjuntos de dados, pertinentes ao dominio de analise de Bioinformatica.

```
</rdfs:comment>
```

```
</owl:Class>
```

```
<owl:Class rdf:ID="Gene_Prediction">
```

```
<rdfs:subClassOf rdf:resource="#Constructive"/>
```

```
</owl:Class>
```

```
<owl:Class rdf:ID="Genome_Comparison">
```

```
<rdfs:subClassOf rdf:resource="#Constructive"/>
```

```
</owl:Class>
```

```
<owl:Class rdf:ID="Phylogenetic Analysis">
```

```
<rdfs:subClassOf rdf:resource="#Constructive"/>
```

</owl:Class>

<owl:Class rdf:ID="Base_Identification">

<rdfs:subClassOf rdf:resource="#Constructive"/>

</owl:Class>

<owl:Class rdf:ID="Pattern_Discovery">

<rdfs:subClassOf rdf:resource="#Constructive"/>

</owl:Class>

<owl:Class rdf:ID="Molecular_Prediction">

<rdfs:subClassOf rdf:resource="#Constructive"/>

</owl:Class>

<owl:Class rdf:ID="Sequence_Assembly">

<rdfs:subClassOf rdf:resource="#Constructive"/>

</owl:Class>

<owl:Class rdf:ID="Pattern_Recognition">

<rdfs:subClassOf rdf:resource="#Constructive"/>

</owl:Class>

<owl:Class rdf:ID="Sequence_Alignment">


```
<rdfs:subClassOf rdf:resource="#Constructive"/>  
</owl:Class>
```

```
<owl:Class rdf:ID="Multiple_Alignment">  
  <rdfs:subClassOf rdf:resource="#Sequence_Alignment"/>  
</owl:Class>
```

```
<owl:Class rdf:ID="MultiAlign">  
  <rdfs:subClassOf rdf:resource="#Multiple_Alignment"/>  
</owl:Class>
```

```
<owl:Class rdf:ID="CLUSTAL_W">  
  <rdfs:subClassOf rdf:resource="#Multiple_Alignment"/>  
</owl:Class>
```

```
<owl:Class rdf:ID="Pairwise_Alignment">  
  <rdfs:subClassOf rdf:resource="#Sequence_Alignment"/>  
</owl:Class>
```

```
<owl:Class rdf:ID="Global_Alignment">  
  <rdfs:subClassOf rdf:resource="#Pairwise_Alignment"/>  
</owl:Class>
```

```
<owl:Class rdf:ID="Local_Alignment">  
  <rdfs:subClassOf rdf:resource="#Pairwise_Alignment"/>  
</owl:Class>
```

```
<owl:Class rdf:ID="Smith_Waterman">  
  <rdfs:subClassOf rdf:resource="#Lobal_Alignment"/>  
</owl:Class>
```

```
<owl:Class rdf:ID="ssearch">  
  <rdfs:subClassOf rdf:resource="#Smith_Waterman"/>  
</owl:Class>
```

```
<owl:Class rdf:ID="BLAST">  
  <rdfs:subClassOf rdf:resource="#Lobal_Alignment"/>  
</owl:Class>
```

```
<owl:Class rdf:ID="BLASTN">  
  <rdfs:subClassOf rdf:resource="#BLAST"/>  
</owl:Class>
```

```
<owl:Class rdf:ID="TBLASTN">  
  <rdfs:subClassOf rdf:resource="#BLAST"/>  
</owl:Class>
```

```
<owl:Class rdf:ID="BLASTP">  
  <rdfs:subClassOf rdf:resource="#BLAST"/>  
</owl:Class>
```

```
<owl:Class rdf:ID="BLASTX">  
  <rdfs:subClassOf rdf:resource="#BLAST"/>  
</owl:Class>
```

```
<owl:Class rdf:ID="TBLASTX">  
  <rdfs:subClassOf rdf:resource="#BLAST"/>  
</owl:Class>
```

```
<owl:Class rdf:ID="FAST">  
  <rdfs:subClassOf rdf:resource="#Local_Alignment"/>  
</owl:Class>
```

```
<owl:Class rdf:ID="FASTA">  
  <rdfs:subClassOf rdf:resource="#FAST"/>  
</owl:Class>
```

```
<owl:Class rdf:ID="TFASTA3">  
  <rdfs:subClassOf rdf:resource="#FAST"/>
```

```
</owl:Class>
```

```
<owl:Class rdf:ID="FASTX3">
```

```
<rdfs:subClassOf rdf:resource="#FAST"/>
```

```
</owl:Class>
```

```
<owl:Class rdf:ID="TFASTX3">
```

```
<rdfs:subClassOf rdf:resource="#FAST"/>
```

```
</owl:Class>
```

```
<owl:Class rdf:ID="FASTY3">
```

```
<rdfs:subClassOf rdf:resource="#FAST"/>
```

```
</owl:Class>
```

```
<owl:Class rdf:ID="TFASTY3">
```

```
<rdfs:subClassOf rdf:resource="#FAST"/>
```

```
</owl:Class>
```

```
<owl:Class rdf:ID="External_Control">
```

```
<rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string">
```

Um processo de controle externo ajuda o pesquisador a gerenciar a execucao do workflow.

```
</rdfs:comment>
```

```
<rdfs:subClassOf rdf:resource="#Process"/>
```

```
</owl:Class>
```

```
<owl:Class rdf:ID="Verification_Point">
```

```
<rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string">
```

Usado sempre em conjunto com um processo P, indica uma condicao, avaliada sobre os contêineres de entrada de P, que deve ser satisfeita para que P seja executado.

```
</rdfs:comment>
```

```
<rdfs:subClassOf rdf:resource="#External_Control"/>
```

```
</owl:Class>
```

```
<owl:Class rdf:ID="Stop_Point">
```

```
<rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string">
```

Indica um ponto em que a execucao do workflow deve parar temporariamente para que o pesquisador analise os resultados intermediarios ja gerados.

```
</rdfs:comment>
```

```
<rdfs:subClassOf rdf:resource="#External_Control"/>
```

```
</owl:Class>
```

```
<owl:Class rdf:ID="Exit_Point">
```

```
<rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string">
```

Indica um ponto em que a execucao do workflow deve parar.

```
</rdfs:comment>
```

```
<rdfs:subClassOf>
```

```
<owl:Class rdf:about="#controle_externo"/>
```

```
</rdfs:subClassOf>
```

```
</owl:Class>
```

```
<owl:Class rdf:ID="Internal_Control">
```

```
<rdfs:subClassOf rdf:resource="#Process"/>
```

```
<rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string">
```

Um processo de controle interno e um processo acrescentado automaticamente pelo sistema de gerencia de workflow para que o funcionamento do workflow se torne coerente, viavel ou mais eficiente.

```
</rdfs:comment>
```

```
</owl:Class>
```

```
<owl:Class rdf:ID="Inspection_Point">
```

```
<rdfs:subClassOf rdf:resource="#Internal_Control"/>
```

```
<rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string">
```

Um processo de inspecao verifica se os dados de entrada e o resultado da execucao de um processo estao corretos ou nao.

```
</rdfs:comment>
```

```
</owl:Class>
```

```
<owl:Class rdf:ID="Format_Transformation_Process">
```

```
<rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string">
```

Um processo de transformacao de formato, como o nome indica, aplica uma transformacao de formato em um conjunto de dados.

```
</rdfs:comment>
```

```
<rdfs:subClassOf rdf:resource="#Internal_Control"/>
```

```
</owl:Class>
```

```
<owl:DatatypeProperty rdf:ID="Popularity">
```

```
<rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string">
```

Medida da porcentagem de pesquisadores que conhecem e utilizam os processos de uma classe.

```
</rdfs:comment>
```

```
<rdfs:domain rdf:resource="#Process"/>
```

```
<rdfs:range rdf:resource="http://www.w3.org/2001/XMLSchema#float"/>
```

```
</owl:DatatypeProperty>
```

```
<owl:DatatypeProperty rdf:ID="Performance">
```

```
<rdfs:domain rdf:resource="#Process"/>
```

```
<rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string">
```

Medida da quantidade de recursos computacionais (como tempo de CPU, acesso a disco, etc...) consumidos pelos processos de uma classe.

```
</rdfs:comment>
```

```
<rdfs:range rdf:resource="http://www.w3.org/2001/XMLSchema#float"/>
```

```
</owl:DatatypeProperty>
```

```
<owl:DatatypeProperty rdf:ID="Fidelity">
```

```
<rdfs:domain rdf:resource="#Process"/>
```

```
<rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string">
```

Medida de quão próximo do ótimo estão, normalmente, os resultados gerados pelos processos de uma classe.

```
</rdfs:comment>
```

```
<rdfs:range rdf:resource="http://www.w3.org/2001/XMLSchema#float"/>
</owl:DatatypeProperty>
```

```
<owl:DatatypeProperty rdf:ID="Cost">
  <rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string">
    Medida do custo financeiro para execucao dos processos de uma classe.
  </rdfs:comment>
  <rdfs:range rdf:resource="http://www.w3.org/2001/XMLSchema#float"/>
  <rdfs:domain rdf:resource="#Process"/>
</owl:DatatypeProperty>
```

```
<owl:DatatypeProperty rdf:ID="Default">
  <rdfs:range rdf:resource="http://www.w3.org/2001/XMLSchema#float"/>
  <rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string">
    Medida que indica o quanto os processos de uma classe sao indicados como opcao padrao para o tipo de tarefa a que se propoem.
  </rdfs:comment>
  <rdfs:domain rdf:resource="#Process"/>
</owl:DatatypeProperty>
```

```
<owl:DatatypeProperty rdf:ID="Adequacy ">
  <rdfs:range rdf:resource="http://www.w3.org/2001/XMLSchema#float"/>
  <rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string">
    Medida que indica o quanto os processos de uma classe sao indicados como opcao para um tipo de projeto.
```



```
</rdfs:comment>
```

```
<rdfs:domain rdf:resource="#Process"/>
```

```
</owl:DatatypeProperty>
```

```
<owl:Class rdf:ID="Container">
```

```
<rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string">
```

Modela uma estruturas de dados responsavel por armazenar e gerenciar um conjunto de dados compartilhado no workflow. Os contêineres que nao sao destino de alguma conexao e que modelam bancos de dados de biosequencias sao tambem chamados de recursos (nao sendo modelados como uma classe separada).

```
</rdfs:comment>
```

```
</owl:Class>
```

```
<owl:Class rdf:ID="Chromatogram_Set">
```

```
<rdfs:subClassOf rdf:resource="#Container"/>
```

```
</owl:Class>
```

```
<owl:Class rdf:ID="Pattern_Set">
```

```
<rdfs:subClassOf rdf:resource="#Container"/>
```

```
</owl:Class>
```

```
<owl:Class rdf:ID="Sequence_Set">
```

```
<rdfs:subClassOf rdf:resource="#Container"/>
```

</owl:Class>

<owl:Class rdf:ID="Aminoacid_Sequence_Set">
 <rdfs:subClassOf rdf:resource="#Sequence_Set"/>
</owl:Class>

<owl:Class rdf:ID="Nucleotide_Sequence_Set">
 <rdfs:subClassOf rdf:resource="#Sequence_Set"/>
</owl:Class>

<owl:Class rdf:ID="Contig_Nucleotide_Sequence_Set">
 <rdfs:subClassOf rdf:resource="#Nucleotide_Sequence_Set"/>
</owl:Class>

<owl:Class rdf:ID="Read_Nucleotide_Sequence_Set">
 <rdfs:subClassOf rdf:resource="#Nucleotide_Sequence_Set"/>
</owl:Class>

<owl:Class rdf:ID="Genome_Nucleotide_Sequence_Set">
 <rdfs:subClassOf rdf:resource="#Nucleotide_Sequence_Set"/>
</owl:Class>

<owl:Class rdf:ID="ORF_Nucleotide_Sequence_Set">

```

<rdfs:subClassOf rdf:resource="#Nucleotide_Sequence_Set"/>
</owl:Class>

<owl:DatatypeProperty rdf:ID="Container_Type">
  <rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string">
    Propriedadde derivada do tipo da conexao.
  </rdfs:comment>
  <rdfs:domain rdf:resource="#Container"/>
  <rdfs:range>
    <owl:DataRange>
      <owl:oneOf rdf:parseType="Resource">
        <rdf:first rdf:datatype="http://www.w3.org/2001/XMLSchema#string">gradative</rdf:first>
        <rdf:rest rdf:parseType="Resource">
          <rdf:first rdf:datatype="http://www.w3.org/2001/XMLSchema#string">not-gradative</rdf:first>
          <rdf:rest rdf:parseType="Resource">
            <rdf:rest rdf:resource="http://www.w3.org/1999/02/22-rdf-syntax-ns#nil"/>
            <rdf:first rdf:datatype="http://www.w3.org/2001/XMLSchema#string">mix</rdf:first>
          </rdf:rest>
        </rdf:rest>
      </owl:oneOf>
    </owl:DataRange>
  </rdfs:range>
</owl:DatatypeProperty>

```

```
<owl:DatatypeProperty rdf:ID="Access_Type">
  <rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string">
    Indica se o contêiner é público ou privado.
  </rdfs:comment>
  <rdfs:domain rdf:resource="#Container"/>
  <rdfs:range>
    <owl:DataRange>
      <owl:oneOf rdf:parseType="Resource">
        <rdf:first rdf:datatype="http://www.w3.org/2001/XMLSchema#string">public</rdf:first>
        <rdf:rest rdf:parseType="Resource">
          <rdf:first rdf:datatype="http://www.w3.org/2001/XMLSchema#string">private</rdf:first>
          <rdf:rest rdf:resource="http://www.w3.org/1999/02/22-rdf-syntax-ns#nil"/>
        </rdf:rest>
      </owl:oneOf>
    </owl:DataRange>
  </rdfs:range>
</owl:DatatypeProperty>

<owl:DatatypeProperty rdf:ID="Estimated_Max_Size">
  <rdfs:range rdf:resource="http://www.w3.org/2001/XMLSchema#float"/>
  <rdfs:domain rdf:resource="#Container"/>
  <rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string">
```

Captura, como o nome indica, o tamanhos maximo estimado para o contêiner.

</rdfs:comment>

</owl:DatatypeProperty>

<owl:DatatypeProperty rdf:ID="Estimated_Min_Size">

<rdfs:range rdf:resource="http://www.w3.org/2001/XMLSchema#float"/>

<rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string">

Captura, como o nome indica, o tamanhos minimo estimado para o contêiner.

</rdfs:comment>

<rdfs:domain rdf:resource="#Container"/>

</owl:DatatypeProperty>

<owl:DatatypeProperty rdf:ID="Format">

<rdfs:range rdf:resource="http://www.w3.org/2001/XMLSchema#string"/>

<rdfs:domain rdf:resource="#Container"/>

<rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string">

Indica o formato dos dados armazenados no contêiner.

</rdfs:comment>

</owl:DatatypeProperty>

<owl:DatatypeProperty rdf:ID="Container_Quality">

<rdfs:range>

<owl:DataRange>

```

<owl:oneOf rdf:parseType="Resource">
  <rdf:rest rdf:parseType="Resource">
    <rdf:first rdf:datatype="http://www.w3.org/2001/XMLSchema#string">Medium</rdf:first>
    <rdf:rest rdf:parseType="Resource">
      <rdf:rest rdf:resource="http://www.w3.org/1999/02/22-rdf-syntax-ns#nil"/>
      <rdf:first rdf:datatype="http://www.w3.org/2001/XMLSchema#string">Low</rdf:first>
    </rdf:rest>
  </rdf:rest>
  <rdf:first rdf:datatype="http://www.w3.org/2001/XMLSchema#string">High</rdf:first>
</owl:oneOf>
</owl:DataRange>
</rdfs:range>
<rdfs:domain rdf:resource="#Container"/>
<rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string">
  Caracteriza a qualidade dos dados em um contêiner, tipicamente um recurso.
</rdfs:comment>
</owl:DatatypeProperty>

<owl:Class rdf:ID="Connection">
  <rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string">
    Modela uma conexao ligando processo a contêiner (ou vice-versa).
  </rdfs:comment>
</owl:Class>

```

```

<owl:DatatypeProperty rdf:ID="Connection_Type">
  <rdfs:range>
    <owl:DataRange>
      <owl:oneOf rdf:parseType="Resource">
        <rdf:rest rdf:parseType="Resource">
          <rdf:rest rdf:resource="http://www.w3.org/1999/02/22-rdf-syntax-ns#nil"/>
          <rdf:first rdf:datatype="http://www.w3.org/2001/XMLSchema#string">not-gradative</rdf:first>
        </rdf:rest>
        <rdf:first rdf:datatype="http://www.w3.org/2001/XMLSchema#string">gradative</rdf:first>
      </owl:oneOf>
    </owl:DataRange>
  </rdfs:range>
  <rdfs:domain rdf:resource="#Connection"/>
  <rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string">
    Indica como o processo escreve os itens de dados no contêiner, ou le itens de dados do contêiner.
  </rdfs:comment>
</owl:DatatypeProperty>

<owl:ObjectProperty rdf:ID="Source">
  <protege:allowedParent rdf:resource="http://www.w3.org/2002/07/owl#Thing"/>
  <protege:allowedParent rdf:resource="#Process"/>
  <rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string">

```

Indica um contêiner ou processo que e a origem da conexao.

```
</rdfs:comment>
<rdfs:range rdf:resource="http://www.w3.org/2002/07/owl#Class"/>
<rdfs:domain rdf:resource="#Connection"/>
<protege:allowedParent rdf:resource="#Container"/>
</owl:ObjectProperty>
```

```
<owl:ObjectProperty rdf:ID="Target">
  <rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string">
```

Indica um contêiner ou processo que e o destino da conexao.

```
</rdfs:comment>
<protege:allowedParent rdf:resource="http://www.w3.org/2002/07/owl#Thing"/>
<rdfs:domain rdf:resource="#Connection"/>
<protege:allowedParent rdf:resource="#Process"/>
<rdfs:range rdf:resource="http://www.w3.org/2002/07/owl#Class"/>
<protege:allowedParent rdf:resource="#Container"/>
</owl:ObjectProperty>
<Pattern_Set rdf:ID="PFam"/>
<Pattern_Set rdf:ID="Blocks"/>
<Pattern_Set rdf:ID="Prosit"/>
<Aminoacid_Sequence_Set rdf:ID="TR-EMBL"/>
<Aminoacid_Sequence_Set rdf:ID="Swiss-Prot"/>
<Aminoacid_Sequence_Set rdf:ID="PIR"/>
```



```
<Aminoacid_Sequence_Set rdf:ID="Genbank-NR"/>  
<Nucleotide_Sequence_Set rdf:ID="EMBL"/>  
<Nucleotide_Sequence_Set rdf:ID="Genbank-NT"/>  
</rdf:RDF>
```

Ontologia em Prolog

%% Project

is_project(est).

is_project(complete).

%% Container

is_container(chromatogram_set).

is_container(sequence_set).

is_container(pattern_set).

is_container(alignment_set).

is_container(S2) :- isa_container(S1,S2), is_container(S1).

isa_container(sequence_set, nucleotide_sequence_set).

isa_container(sequence_set, aminoacid_sequence_set).

isa_container(nucleotide_sequence_set, nucleotide_sequence_resource).

isa_container(nucleotide_sequence_resource, genbank_nt).

isa_container(nucleotide_sequence_resource, embl).

isa_container(aminoacid_sequence_set, aminoacid_sequence_resource).

isa_container(aminoacid_sequence_resource, genbank_nr).

isa_container(aminoacid_sequence_resource, pir).

isa_container(aminoacid_sequence_resource, swissprot).
isa_container(aminoacid_sequence_resource, trembl).
isa_container(pattern_set, pattern_resource).
isa_container(pattern_resource, prosite).
isa_container(pattern_resource, pfam).
isa_container(pattern_resource, blocks).
isa_container(nucleotide_sequence_set, read_nucleotide_sequence_set).
isa_container(nucleotide_sequence_set, contig_nucleotide_sequence_set).
isa_container(nucleotide_sequence_set, orf_nucleotide_sequence_set).
isa_container(nucleotide_sequence_set, genome_sequence_set).
isa_container(aminoacid_sequence_set, orf_aminoacid_sequence_set).
isa_container(aminoacid_sequence_set, contig_aminoacid_sequence_set).
isa_container(aminoacid_sequence_set, read_aminoacid_sequence_set).
isa_container(pattern_set, regular_expression_set).
isa_container(alignment_set, nucleotide_alignment_set).
isa_container(alignment_set, aminoacid_alignment_set).
is_container_type(gradative).
is_container_type(not_gradative).
is_container_type(mix).
is_container_accesstype(public).
is_container_accesstype(private).
is_container_dataformat(chromatogram_set_scf_format).
is_container_dataformat(chromatogram_set_abi_format).

```
is_container_dataformat(sequence_set_phd_format).
is_container_dataformat(sequence_set_ace_format).
is_container_dataformat(sequence_set_fasta_format).
is_container_dataformat(nucleotide_sequence_set_fasta_format).
is_container_dataformat(aminoacid_sequence_set_fasta_format).
is_container_dataformat(alignment_set_clustalw_format).
is_container_dataformat(alignment_set_multialign_format).
is_container_dataformat(alignment_set_ssearch_format).
is_container_dataformat(alignment_set_blast_format).
is_container_dataformat(alignment_set_fast_format).
is_container_dataformat(regular_expression_set_fasta_format).
```

%% Process

```
is_process(P) :- is_internal_control_process(P).
is_process(P) :- is_external_control_process(P).
is_process(P) :- is_filter_process(P).
is_process(P) :- is_internal_constructive_process(P).
```

%% Internal Control Process

```
is_internal_control_process(inspection).
is_internal_control_process(format_transformation).
is_internal_control_process(S2) :- isa_internal_control_process(S1,S2), is_internal_control_process(S1).
isa_constructive_process(format_transformation, phd2fasta).
```

```
isa_constructive_process(format_transformation, emboss_transeq).
```

```
%% External Control Process
```

```
is_external_control_process(if).
```

```
is_external_control_process(exit).
```

```
is_external_control_process(stop).
```

```
%% Filter Process
```

```
is_filter_process(bat).
```

```
is_filter_process(mspcrunch).
```

```
%% Constructive Process
```

```
is_constructive_process(base_identification).
```

```
is_constructive_process(sequence_assembly).
```

```
is_constructive_process(sequence_alignment).
```

```
is_constructive_process(gene_prediction).
```

```
is_constructive_process(pattern_discovery).
```

```
is_constructive_process(S2) :- isa_constructive_process(S1,S2), is_constructive_process(S1).
```

```
isa_constructive_process(base_identification, phred).
```

```
isa_constructive_process(base_identification, abiview).
```

```
isa_constructive_process(base_identification, chromas).
```

```
isa_constructive_process(sequence_assembly, cap3).
```

```
isa_constructive_process(sequence_assembly, phrap).
```

isa_constructive_process(sequence_assembly, tigr_assembler).
isa_constructive_process(sequence_alignment, multiple_alignment).
isa_constructive_process(sequence_alignment, pairwise_alignment).
isa_constructive_process(multiple_alignment, clustalW).
isa_constructive_process(multiple_alignment, multiAlign).
isa_constructive_process(pairwise_alignment, global_alignment).
isa_constructive_process(pairwise_alignment, local_alignment).
isa_constructive_process(global_alignment, ssearch).
isa_constructive_process(local_alignment, blast).
isa_constructive_process(local_alignment, fast).
isa_constructive_process(blast, blastp).
isa_constructive_process(blast, blastn).
isa_constructive_process(blast, tblastx).
isa_constructive_process(blast, tblastn).
isa_constructive_process(blast, blastx).
isa_constructive_process(fast, fasta3).
isa_constructive_process(fast, fasty3).
isa_constructive_process(fast, fastx3).
isa_constructive_process(fast, tfastx3).
isa_constructive_process(fast, tfasty3).
isa_constructive_process(fast, tfasta3).
isa_constructive_process(gene_prediction, glimmer).
isa_constructive_process(pattern_discovery, teireisias).

%% Constructive Process- Properties

%% Process - Description

is_process_description(base_identification,'Bases identification: writes the base calls of DNA sequences.').

is_process_description(sequence_assembly,'Sequence assembly programs.').

is_process_description(sequence_alignment,'Sequence alignment programs.').

is_process_description(gene_prediction,'Gene prediction programs.').

is_process_description(pattern_discovery,'Pattern discovery programs.').

is_process_description(phred,'Phred reads DNA sequencer trace data, calls bases, assigns quality values to the bases, and writes the base calls and quality values to output files.').

is_process_description(abiview,'Abiview is a free sequence assembly program.').

is_process_description(chromas,'Chromas is a sequence assembly program which requires Windows 95/NT4.0 or higher and is shareware').

is_process_description(cap3,'Cap3 is a DNA sequence assembly program.').

is_process_description(phrap,'Phrap is a program for assembling shotgun DNA sequence data').

is_process_description(tigr_assembler,'The TIGR Assembler is the classic assembly tool developed by TIGR to build a consensus sequence from smaller sequence fragments.').

is_process_description(multiple_alignment,'Alignment is calculated between multiple sequences.').

is_process_description(pairwise_alignment,'Alignment is calculated between two sequences.').

is_process_description(clustalW,'ClustalW is a multiple alignment program.').

is_process_description(multiAlign,'MultiAlign is a multiple alignment program').

is_process_description(global_alignment,'Global alignment is calculated taking into consideration the total length of the two sequences being compared.').

is_process_description(local_alignment,'Local alignment is calculated taking into consideration alignments between substrings of the sequences.').

is_process_description(sssearch,'Search compares a protein or DNA sequence to a sequence database using the Smith-Waterman algorithm.').

is_process_description(blast,'Blast is a sequence comparison program family.').

is_process_description(fast,'Fast is a sequence comparison program family.').

is_process_description(blastp,'Blastp compares an amino acid query sequence against a protein sequence database').

is_process_description(blastn,'Blastn compares a nucleotide query sequence against a nucleotide sequence database').

is_process_description(tblastx,'Tblastn compares a protein query sequence against a nucleotide sequence database dynamically translated in all six reading frames (both strands.').

is_process_description(tblastn,'Tblastx compares the six-frame translations of a nucleotide query sequence against the six-frame translations of a nucleotide sequence database.').

is_process_description(blastx,'Blastx compares the six-frame conceptual translation products of a nucleotide query sequence (both strands) against a protein sequence database').

is_process_description(fasta3,'Fasta3 scans a protein or DNA sequence library for similar sequences').

is_process_description(fasty3,'Fasty3 compares a DNA sequence to a protein sequence database, comparing the translated DNA sequence in forward and reverse frames.').

is_process_description(fastx3,'Fastx3 compares a DNA sequence to a protein sequence database, comparing the translated DNA sequence in forward and reverse frames. ').

is_process_description(tfastx3,'Tfastx3 compares a protein sequence to a DNA sequence database, calculating similarities with frameshifts to the forward and reverse orientations.').

is_process_description(tfasty3,'Tfasty3 compares a protein sequence to a DNA sequence database, calculating similarities with frameshifts to the forward and reverse orientations.').

is_process_description(tfasta3,'Tfasta3 compares a protein sequence to a DNA sequence library, translating the DNA sequence library on-the-fly').

is_process_description(phd2fasta,'Phd2fasta is a program to make the fasta format sequence file from the .phd files generated by phred').

%% Process - Parameter

%% Phred - Disable phred base calling and set the current sequence to the ABI base calls that are read from the input file.

%% By default, the current sequence is set to the phred base calls.

is_constructive_process_parameter(phred,nocall,false).

%% Phred - Perform sequence trimming on the current sequence (to permit trimming off low quality segments of reads that are not destined for assembly).

is_constructive_process_parameter(phred,trim,false).

%% Phrap - forcelevel relaxes stringency to varying degree during final contig merge pass. Allowed values are integers from 0 (most stringent) to 10 (least stringent), inclusive.

is_constructive_process_parameter(phrap,forcelevel,0).

%% Phrap - maxgap is the maximum permitted size of an unmatched region in merging contigs, during first (most stringent) merging pass.

is_constructive_process_parameter(phrap,maxgap,30).

%% BLAST - word length.

is_constructive_process_parameter(blastp,w,3).

is_constructive_process_parameter(blastx,w,3).

is_constructive_process_parameter(tblastn,w,3).

is_constructive_process_parameter(tblastx,w,3).

is_constructive_process_parameter(blastn,w,11).

%% BLAST - number of matches one expects to observe by chance alone during the database search.

is_constructive_process_parameter(blastp,e,10).

is_constructive_process_parameter(blastx,e,10).

is_constructive_process_parameter(tblastn,e,10).

is_constructive_process_parameter(tblastx,e,10).

is_constructive_process_parameter(blastn,e,10).

%% BLAST - Using the -dbrecmax option, the record number of the last database sequence to search can be specified.

%% By default the BLAST programs search the entire database.

is_constructive_process_parameter(blastp,dbrecmax,entire_database).

is_constructive_process_parameter(blastx,dbrecmax,entire_database).

is_constructive_process_parameter(tblastn,dbrecmax,entire_database).

is_constructive_process_parameter(tblastx,dbrecmax,entire_database).

is_constructive_process_parameter(blastn,dbrecmax,entire_database).

%% BLAST - Using the -dbrecmin option, the record number of the first database sequence to search can be specified.

%% By default the BLAST programs search the entire database.

is_constructive_process_parameter(blastp,dbrecmin,entire_database).

is_constructive_process_parameter(blastx,dbrecmin,entire_database).

is_constructive_process_parameter(tblastn,dbrecmin,entire_database).

is_constructive_process_parameter(tblastx,dbrecmin,entire_database).

is_constructive_process_parameter(blastn,dbrecmin,entire_database).

%% BLAST - Governing Output

%% Parameter hspmax can be used to limit the number of HSPs reported per database sequence.

%% The default limit is 1000, which is ample leeway for most searches.

%% Notable exceptions are when long query sequences are used (e.g., an entire cosmid) and numerous repetitive or low-complexity (lowentropy) regions exist in the query and database sequences.

is_constructive_process_parameter(blastp,hspmax,1000).

is_constructive_process_parameter(blastx,hspmax,1000).

is_constructive_process_parameter(tblastn,hspmax,1000).

is_constructive_process_parameter(tblastx,hspmax,1000).

is_constructive_process_parameter(blastn,hspmax,1000).

%% BLAST - Governing Output

%% Parameter V is the maximum number of database sequences for which one-line descriptions will be reported.

%% The default value for V is 500.

is_constructive_process_parameter(blastp,b,10).

is_constructive_process_parameter(blastx,b,10).

is_constructive_process_parameter(tblastn,b,10).

is_constructive_process_parameter(tblastx,b,10).

is_constructive_process_parameter(blastn,b,10).

%% BLAST - Governing Output

%% Parameter B regulates the display of the high-scoring segment pairs (alignments). For positive values, B is the maximum number of database sequences for which high-scoring segment pairs will be reported.

%% This may be much smaller than the actual number of high-scoring segment pairs reported, since any given database sequence may yield several HSPs.

%% The default value for B is 250.

is_constructive_process_parameter(blastp,b,10).

is_constructive_process_parameter(blastx,b,10).

is_constructive_process_parameter(tblastn,b,10).

is_constructive_process_parameter(tblastx,b,10).

is_constructive_process_parameter(blastn,b,10).

%% ssearch - Governing Output

%% scores specify how many homologous sequences are reported in list of homology scores.

%% The default value is 100.

is_constructive_process_parameter(ssearch,scores,100).

%% ssearch - Governing Output

%% alignments specify how many alignments with homologous sequences are reported.

%% The default value is 100.

is_constructive_process_parameter(ssearch,alignments,100).

%% Process - Quality

is_constructive_process_quality(phred,cost,10).

is_constructive_process_quality(abiview,cost,0).

is_constructive_process_quality(chromas,cost,0).

is_constructive_process_quality(phred,popularity,10).

is_constructive_process_quality(abiview,popularity,5).
is_constructive_process_quality(chromas,popularity,5).
is_constructive_process_quality(phrap,popularity,10).
is_constructive_process_quality(cap3,popularity,10).
is_constructive_process_quality(tigr_assembler,popularity,5).
is_constructive_process_quality(phrap,adequacy, est, 5).
is_constructive_process_quality(phrap,adequacy, complete,10).
is_constructive_process_quality(cap3,adequacy,est,10).
is_constructive_process_quality(cap3,adequacy,complete,5).
is_constructive_process_quality(tigr_assembler,adequacy,est,10).
is_constructive_process_quality(tigr_assembler,adequacy,complete,5).
is_constructive_process_quality(blast,performance,8).
is_constructive_process_quality(fast,performance,5).
is_constructive_process_quality(blast,fidelity,5).
is_constructive_process_quality(fast,fidelity,8).
is_constructive_process_quality(blast,default,10).
is_constructive_process_quality(fast,default,5).
is_constructive_process_quality(blast,popularity,10).
is_constructive_process_quality(fast,popularity,5).
is_constructive_process_quality(fastx3,performance,10).
is_constructive_process_quality(fasty3,performance,5).
is_constructive_process_quality(fastx3,fidelity,5).
is_constructive_process_quality(fasty3,fidelity,10).

is_constructive_process_quality(tfasta3,performance,10).
is_constructive_process_quality(tfastx3,performance,7).
is_constructive_process_quality(tfasty3,performance,5).
is_constructive_process_quality(tfasta3,fidelity,5).
is_constructive_process_quality(tfastx3,fidelity,7).
is_constructive_process_quality(tfasty3,fidelity,10).
is_constructive_process_quality(tfastx3,default,10).
is_constructive_process_quality(tfasty3,default,10).
is_constructive_process_quality(tfasta3,default,5).
is_constructive_process_quality(blastp,performance,10).
is_constructive_process_quality(blastx,performance,8).
is_constructive_process_quality(tblastn,performance,6).
is_constructive_process_quality(tblastx,performance,5).
is_constructive_process_quality(blastp,fidelity,5).
is_constructive_process_quality(blastx,fidelity,6).
is_constructive_process_quality(tblastn,fidelity,8).
is_constructive_process_quality(tblastx,fidelity,10).
is_constructive_process_quality(blastp,default,10).
is_constructive_process_quality(blastx,default,8).
is_constructive_process_quality(tblastn,default,6).
is_constructive_process_quality(tblastx,default,5).

%% RELATIONSHIPS

%% Constructive Process - Filter Programs

is_constructive_filter_process(blastp,mspcrunch).

is_constructive_filter_process(blastp,bat).

%% Format Transformation Programs

is_internal_format_transformation_process(emboss_transeq, nucleotide_sequence_set_fasta_format,aminoacid_sequence_set_fasta_format).

%% Process and its input data, output data, resource

bioprocess_restriction(phred,[chromatogram_set],[read_nucleotide_sequence_set],[[]]).

bioprocess_restriction(abiview,[chromatogram_set],[read_nucleotide_sequence_set],[[]]).

bioprocess_restriction(chromas,[chromatogram_set],[read_nucleotide_sequence_set],[[]]).

bioprocess_restriction(cap3,[read_nucleotide_sequence_set],[contig_nucleotide_sequence_set],[[]]).

bioprocess_restriction(phrap,[read_nucleotide_sequence_set],[contig_nucleotide_sequence_set],[[]]).

bioprocess_restriction(clustalW,[sequence_set],[alignment_set],[[]]).

bioprocess_restriction(multiAlign,[sequence_set],[alignment_set],[[]]).

bioprocess_restriction(ssearch,[aminoacid_sequence_set],[aminoacid_alignment_set],[aminoacid_sequence_resource]).

bioprocess_restriction(ssearch,[nucleotide_sequence_set],[nucleotide_alignment_set],[nucleotide_sequence_resource]).

bioprocess_restriction(blastp,[aminoacid_sequence_set],[aminoacid_alignment_set],[aminoacid_sequence_resource]).

bioprocess_restriction(blastn,[nucleotide_sequence_set],[nucleotide_alignment_set],[nucleotide_sequence_resource]).

bioprocess_restriction(tblastx,[nucleotide_sequence_set],[aminoacid_alignment_set],[nucleotide_sequence_resource]).

bioprocess_restriction(blastx,[nucleotide_sequence_set],[aminoacid_alignment_set],[aminoacid_sequence_resource]).

bioprocess_restriction(tblastn,[aminoacid_sequence_set],[aminoacid_alignment_set],[nucleotide_sequence_resource]).

```

bioprocess_restriction(fasta3,[aminoacid_sequence_set],[aminoacid_alignment_set],[aminoacid_sequence_resource]).
bioprocess_restriction(fasta3,[nucleotide_sequence_set],[nucleotide_alignment_set],[nucleotide_sequence_resource]).
bioprocess_restriction(fasty3,[nucleotide_sequence_set],[aminoacid_alignment_set],[aminoacid_sequence_resource]).
bioprocess_restriction(fastx3,[nucleotide_sequence_set],[aminoacid_alignment_set],[aminoacid_sequence_resource]).
bioprocess_restriction(tfastx3,[aminoacid_sequence_set],[aminoacid_alignment_set],[nucleotide_sequence_resource]).
bioprocess_restriction(tfasty3,[aminoacid_sequence_set],[aminoacid_alignment_set],[nucleotide_sequence_resource]).
bioprocess_restriction(tfasta3,[aminoacid_sequence_set],[aminoacid_alignment_set],[nucleotide_sequence_resource]).
bioprocess_restriction(glimmer,[genome_sequence_set],[orf_nucleotide_sequence_set],[[]]).
bioprocess_restriction(teireisias,[sequence_set],[regular_expression_set],[[]]).

```

```

bioprocess_restriction_input(P,R):- bioprocess_restriction(P,Le,Lo,Lr), in(R,Le).
in(R,[R|T]).                % R is first element of the list
in(R,[F|T]) :- in(R,T).      % R is the rest of the list

```

```

bioprocess_restriction_output(P,R):- bioprocess_restriction(P,Le,Lo,Lr), out(R,Lo).
out(R,[R|T]).
out(R,[F|T]) :- out(R,T).

```

```

bioprocess_restriction_resource(P,R):- bioprocess_restriction(P,Le,Lo,Lr), res(R,Lr).
res(R,[R|T]).
res(R,[F|T]) :- res(R,T).

```

```

%% Process and its input data, output data and resource format data

```



```
bioprocess_restriction_internal_format(phred,[chromatogram_set_scf_format],[sequence_set_phd_format],[]).
bioprocess_restriction_internal_format(phred,[chromatogram_set_abi_format],[sequence_set_phd_format],[]).
bioprocess_restriction_internal_format(phred,[chromatogram_set_scf_format],[sequence_set_fasta_format],[]).
bioprocess_restriction_internal_format(phred,[chromatogram_set_abi_format],[sequence_set_fasta_format],[]).
bioprocess_restriction_internal_format(abiview,[chromatogram_set_abi_format],[sequence_set_fasta_format],[]).
bioprocess_restriction_internal_format(chromas,[chromatogram_set_scf_format],[sequence_set_fasta_format],[]).
bioprocess_restriction_internal_format(chromas,[chromatogram_set_abi_format],[sequence_set_fasta_format],[]).
bioprocess_restriction_internal_format(cap3,[sequence_set_fasta_format],[sequence_set_fasta_format],[]).
bioprocess_restriction_internal_format(cap3,[sequence_set_fasta_format],[sequence_set_ace_format],[]).
bioprocess_restriction_internal_format(phrap,[sequence_set_fasta_format],[sequence_set_fasta_format],[]).
bioprocess_restriction_internal_format(phrap,[sequence_set_fasta_format],[sequence_set_ace_format],[]).
bioprocess_restriction_internal_format(clustalW,[sequence_set_fasta_format],[alignment_set_clustalw_format],[]).
bioprocess_restriction_internal_format(multiAlign,[sequence_set_fasta_format],[alignment_set_multialign_format],[]).
bioprocess_restriction_internal_format(ssearch,[sequence_set_fasta_format],[alignment_set_ssearch_format],[aminoacid_sequence_set_fasta_format]).
bioprocess_restriction_internal_format(blastp,[aminoacid_sequence_set_fasta_format],[alignment_set_blast_format],[aminoacid_sequence_set_fasta_format]).
bioprocess_restriction_internal_format(blastn,[nucleotide_sequence_set_fasta_format],[alignment_set_blast_format],[nucleotide_sequence_set_fasta_format]).
bioprocess_restriction_internal_format(tblastx,[nucleotide_sequence_set_fasta_format],[alignment_set_blast_format],[nucleotide_sequence_set_fasta_format]).
bioprocess_restriction_internal_format(blastx,[nucleotide_sequence_set_fasta_format],[alignment_set_blast_format],[aminoacid_sequence_set_fasta_format]).
bioprocess_restriction_internal_format(tblastn,[aminoacid_sequence_set_fasta_format],[alignment_set_blast_format],[aminoacid_sequence_set_fasta_format]).
bioprocess_restriction_internal_format(fasta3,[aminoacid_sequence_set_fasta_format],[alignment_set_fast_format],[aminoacid_sequence_set_fasta_format]).
bioprocess_restriction_internal_format(fasta3,[nucleotide_sequence_set_fasta_format],[alignment_set_fast_format],[aminoacid_sequence_set_fasta_format]).
bioprocess_restriction_internal_format(fasty3,[nucleotide_sequence_set_fasta_format],[alignment_set_fast_format],[aminoacid_sequence_set_fasta_format]).
bioprocess_restriction_internal_format(fastx3,[nucleotide_sequence_set_fasta_format],[alignment_set_fast_format],[aminoacid_sequence_set_fasta_format]).
```

```

bioprocess_restriction_internal_format(tfastx3,[aminoacid_sequence_set_fasta_format],[alignment_set_fast_format],[nucleotide_sequence_set_fasta_format]).
bioprocess_restriction_internal_format(tfasty3,[aminoacid_sequence_set_fasta_format],[alignment_set_fast_format],[nucleotide_sequence_set_fasta_format]).
bioprocess_restriction_internal_format(tfasta3,[aminoacid_sequence_set_fasta_format],[alignment_set_fast_format],[nucleotide_sequence_set_fasta_format]).
bioprocess_restriction_internal_format(glimmer,[sequence_set_fasta_format],[nucleotide_sequence_set_fasta_format],[ ]).
bioprocess_restriction_internal_format(teireisias,[sequence_set_fasta_format],[regular_expression_set_fasta_format],[ ]).
bioprocess_restriction_input_internal_format(P,R):- bioprocess_restriction_internal_format(P,Le,Lo,Lr), inIF(R,Le).
inIF(R,[R|T]).
inIF(R,[F|T]) :- inIF(R,T).

```

```

bioprocess_restriction_output_internal_format(P,R):- bioprocess_restriction_internal_format(P,Le,Lo,Lr), outIF(R,Lo).
outIF(R,[R|T]).
outIF(R,[F|T]) :- outIF(R,T).

```

```

bioprocess_restriction_resource_internal_format(P,R):- bioprocess_restriction_internal_format(P,Le,Lo,Lr), resIF(R,Lr).
resIF(R,[R|T]).
resIF(R,[F|T]) :- resIF(R,T).

```

%% Process and Containers - Connection Type

```

is_connection_gradative(phred,[yes],[yes],[ ]).
is_connection_gradative(phred,[yes],[yes],[ ]).
is_connection_gradative(abiview,[yes],[yes],[ ]).
is_connection_gradative(chromas,[yes],[yes],[ ]).

```

```

is_connection_gradative(cap3,[no],[yes],[ ]).
is_connection_gradative(phrap,[no],[yes],[ ]).
is_connection_gradative(clustalW,[no],[no],[ ]).
is_connection_gradative(multiAlign,[no],[no],[ ]).
is_connection_gradative(ssearch,[yes],[yes],[no]).
is_connection_gradative(blastp,[yes],[yes],[no]).
is_connection_gradative(blastn,[yes],[yes],[no]).
is_connection_gradative(tblastx,[yes],[yes],[no]).
is_connection_gradative(blastx,[yes],[yes],[no]).
is_connection_gradative(tblastn,[yes],[yes],[no]).
is_connection_gradative(fasta3,[yes],[yes],[no]).
is_connection_gradative(fasty3,[yes],[yes],[no]).
is_connection_gradative(fastx3,[yes],[yes],[no]).
is_connection_gradative(tfastx3,[yes],[yes],[no]).
is_connection_gradative(tfasty3,[yes],[yes],[no]).
is_connection_gradative(tfasta3,[yes],[yes],[no]).
is_connection_gradative(glimmer,[no],[yes],[ ]).
is_connection_gradative(teireisias,[yes],[yes],[ ]).

```

```

bioprocess_restriction_input_gradative(P,R):- is_connection_gradative(P,Le,Lo,Lr), inSW(R,Le).
inSW(R,[R|T]).
inSW(R,[F|T]) :- inSW(R,T).

```

bioprocess_restriction_output_gradative(P,R):- is_connection_gradative(P,Le,Lo,Lr), outSW(R,Lo).

outSW(R,[R|T]).

outSW(R,[F|T]) :- outSW(R,T).

bioprocess_restriction_resource_gradative(P,R):- is_connection_gradative(P,Le,Lo,Lr), resSW(R,Lr).

resSW(R,[R|T]).

resSW(R,[F|T]) :- resSW(R,T).