Introducing DISPEL

Data-Intensive Process Engineering Language

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DIR Theme Workshop

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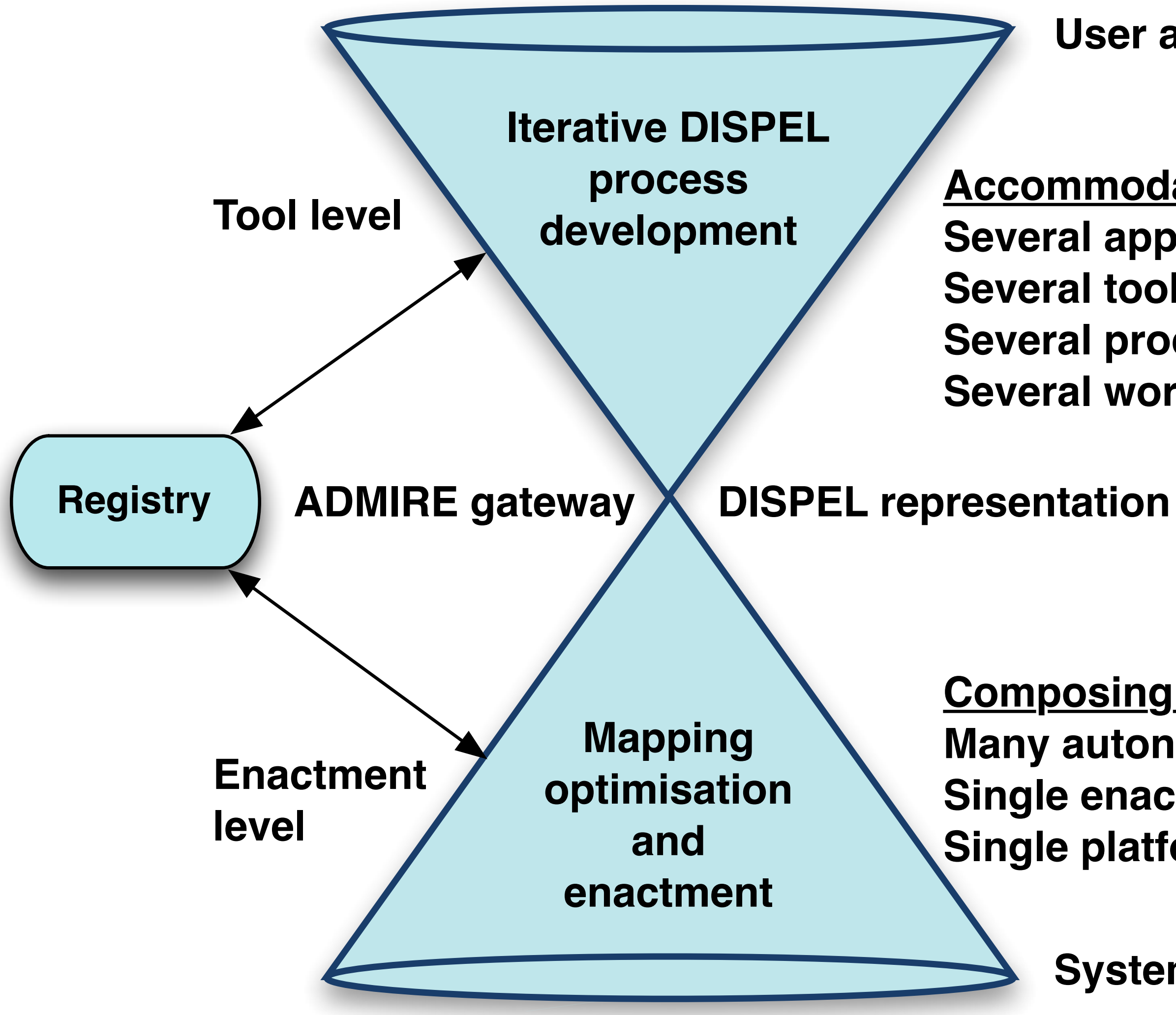
www.admire-project.eu

ADMIRE – Framework 7 ICT 215024

Agenda

- DISPEL's raison d'être
- Success criteria
- Operational model
- Universe of Discourse
- Types and Validation
- Description & Context-driven graph logic



User and application diversity

<u>Accommodating</u>
Several application domains
Several tool sets
Several process representations
Several working practices

<u>Composing or hiding</u>
Many autonomous resources & services
Single enactment mechanism
Single platform implementations

System complexity

	Architectural Level		
	Tool	Gateway & DISPEL	Enactment
Domain Experts			
Data-Analysis Experts			
Data-Intensive Engineers			

DISPEL's raison d'être

- Support each category of expert
- Encourage distributed sharing
- Facilitate independent autonomous development
- Enable safe distributed evaluation
- Usual language goals
  - balance parsimony with power
  - look familiar so gets adopted

Success criteria

- To meet those goals well
  - simple composition + parametric use for Domain Experts
  - sophisticated development of algorithms and workflows for Data-Analysis Experts
  - sophisticated analysis and development of patterns for Data-Intensive Engineers
- Readable and comprehensible
- Efficient and optimisable enactment
- Integrating technical dialogue in ADMIRE

Operational model

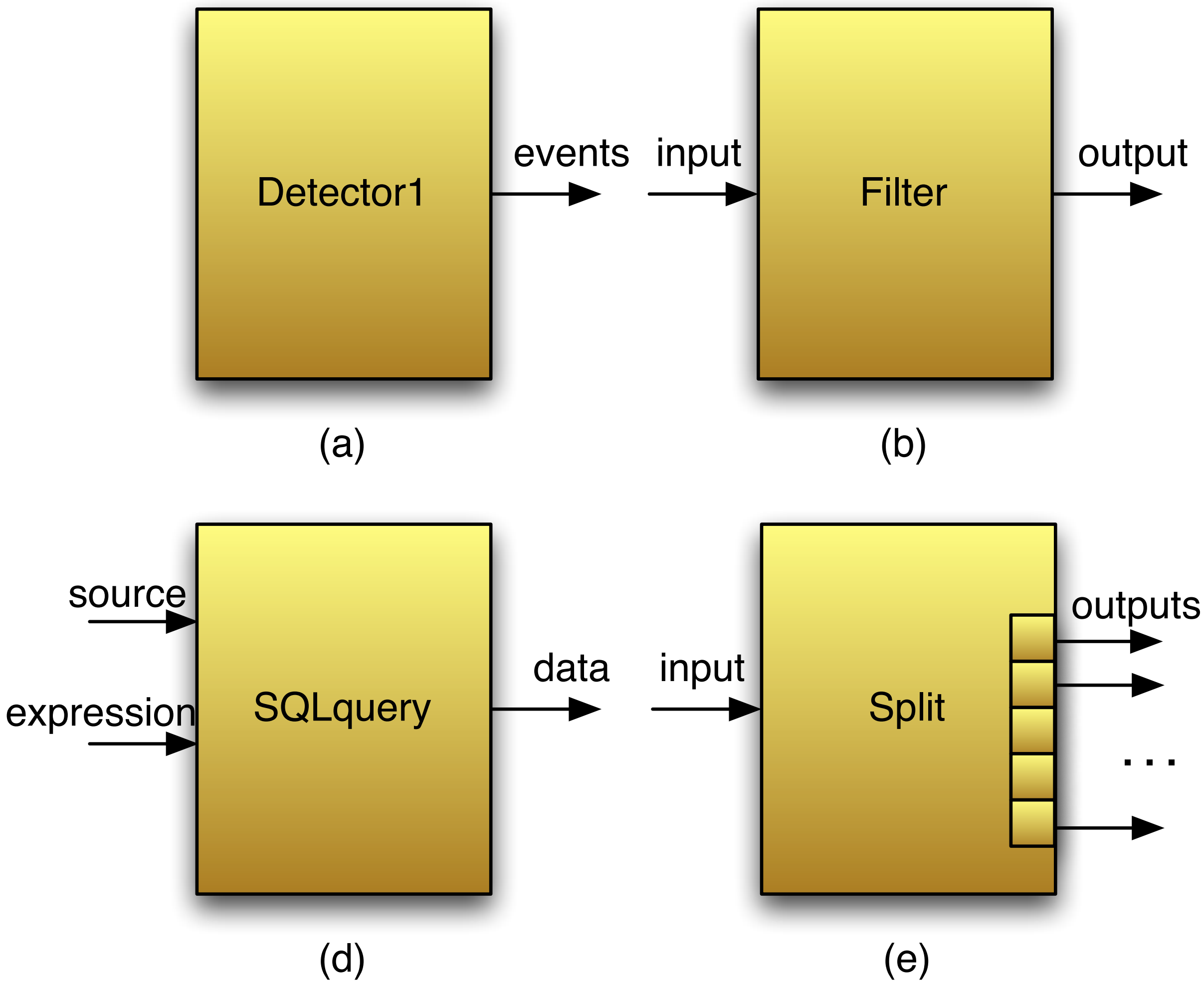
- Language processing
  - extraction from Registry
  - compilation & execution generating directed graph
- Distributed streaming enactment
  - Graph validation & optimisation
  - Resource allocation and deployment
  - Evaluation, monitoring, termination & clean up

Universe of Discourse

- Processing Elements
- Data-Streaming Connections
- Streams
- Three-level Type System
- Functions
- Registry-held descriptions
  – for all of the above
  – organised as packages/libraries

...making knowledge discovery easier

Example Processing Elements



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...making data-mining easier

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- Their known subtype hierarchy

PE instances (PEIs)

- PEs are instantiated before they are used in an enactment
  - **new** PE_expression
- There may be many instances of a given PE
  - Think PE is a class
  - PEI is an instance of that class
- Assertions may refine the properties of a PE instance
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Even more useful for asserting domain types

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The "make a connection" operator

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  - structural type (**Stype**)
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keywords for declaring structural and domain types

Start and end of stream symbols

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PE Termination

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PE Termination

- The *default* termination behaviour occurs when either all the inputs are exhausted or all the receivers of outputs have indicated they do not want more data
  - When all of a PE's inputs have received **EoS**
    - a PE completes the use of its current data
    - then sends an EoS on all of its outputs
    - then stops
  - When all of a PE's outputs have received a "no more"
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But see later slides on PE type definitions and assertions for **terminator** keyword

Types and Validation

- Language Types
  - ensuring correct composition of terms in DISPEL
- Structural Types
  - tracking consistent structure/format along connections
  - PE input requirements output assertions
- Domain Types
  - tracking consistent meaning / interpretation along connections
  - PE input requirements and output assertions

A PE with specific termination

```
package eu.admire{
  namespace rdb “http://www.iso.org/iso/concept_database_cdb#”;

  Type SQLquery is PE (
    <Connection locator: String:: “rdb:Database_URI” resource;
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  register SQLquery;
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The structural type of the result is a list of tuples; **rest** indicates we don't know anything about the fields in the tuples

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make rdb an abbreviation for the domain name prefix

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The Connection attribute **locator** indicates that this a PE whose instances might usefully be `anchored' close to the specified data source by the optimiser. This is particularly relevant if this input is connected to a stream literal.

Defining a DISPEL function

```
package eu.admire{
  namespace rdb "http://www.iso.org/iso/concept_database_cdb#";
  use uk.org.ogsadai.SQLQuery;

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Constructing an infinite sequence of the supplied URI

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Make available for future **use**

Make n-way merge tree

```
package eu.admire {
  use eu.admire.Combiner;

  PE <Combiner> makeMwayCombiner(Integer m, PE <Combiner> BC) {
    if ((new BC).inputs.length != 2) then  {
      throw new ParameterException(
      "BC.inputs parameter provided to makeMwayCombiner not binary" );
      return null;
    };
    if (m <= 0) then {
      throw new ParameterException( "m <= 0 in makeMwayCombiner" );
      return null;
    };
    if (m == 1 ) then  {
      BC bc = new BC;
      |- -| => bc.inputs[1];
      return Combiner( <Connection inputs[0] = bc.inputs[0]> =>
                       <Connection output = bc.output> );
    };
    if (m == 2 ) then {
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Defensively catch errors in the supplied parameters. Normally necessary but not shown in all the other patterns.

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Deal with special cases and bottom out the recursive build.

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                             <Connection output = bc.output> );
  };
  if (m == 2 ) then {
    return BC;
  };
  Connection[ ] inputs = new Connection[m];
  Integer half = m / 2;
  Integer otherHalf = m - half;
  Combiner FirstTree = makeMwayCombiner( half, BC );
  Combiner SecondTree = makeMwayCombiner( otherHalf, BC );
  Combiner ft = new FirstTree;
  Combiner st = new SecondTree;
  Combiner base = new BC;
  Integer deposit = 0;
  for (Integer i = 0; i<half; i++) {
    inputs[deposit] => ft.inputs[i];
    deposit++;
  };
  for (Integer i = 0; i<otherHalf; i++) {
    inputs[deposit] => st.inputs[i];
    deposit++;
  };
  ft.output => base.inputs[0];
  st.output => base.inputs[1];
  return Combiner( <Connection[ ] inputs = inputs> =>
                          <Connection output = base.output> );
}
```

```
    return Combiner( <Connection inputs[0] = bc.inpu
                     <Connection outp
  };
  if (m == 2 ) then {
    return BC;
  };
  Connection[ ] inputs = new Connection[m];
  Integer half = m / 2;
  Integer otherHalf = m - half;
  Combiner FirstTree = makeMwayCombiner( half, BC );
  Combiner SecondTree = makeMwayCombiner( otherHalf, BC );
  Combiner ft = new FirstTree;
  Combiner st = new SecondTree;
  Combiner base = new BC;
  Integer deposit = 0;
  for (Integer i = 0; i<half; i++) {
    inputs[deposit] => ft.inputs[i];
    deposit++;
  };
  for (Integer i = 0; i<otherHalf; i++) {
    inputs[deposit] => st.inputs[i];
    deposit++;
  };
  ft.output => base.inputs[0];
  st.output => base.inputs[1];
  return Combiner( <Connection[ ] inputs = inputs> =>
                   <Connection output = base.output> );
}
```

Build two subtrees and join them together with an instance of the supplied binary combiner BC

```
    Combiner FirstTree = makeMwayCombiner( half, BC );
    Combiner SecondTree = makeMwayCombiner( otherHalf, BC );
    Combiner ft = new FirstTree;
    Combiner st = new SecondTree;
    Combiner base = new BC;
    Integer deposit = 0;
    for (Integer i = 0; i<half; i++) {
      inputs[deposit] => ft.inputs[i];
      deposit++;
    };
    for (Integer i = 0; i<otherHalf; i++) {
      inputs[deposit] => st.inputs[i];
      deposit++;
    };
    ft.output => base.inputs[0];
    st.output => base.inputs[1];
    return Combiner( <Connection[ ] inputs = inputs> =>
                     <Connection output = base.output> );
  }

  register makeMwayCombiner;
}
```

```
    Combiner FirstTree = makeMwayCombiner( half, BC );
    Combiner SecondTree = makeMwayCombiner( otherHalf, BC );
    Combiner ft = new FirstTree;
    Combiner st = new SecondTree;
    Combiner base = new BC;
    Integer deposit = 0;
    for (Integer i = 0; i<half; i++) {
      inputs[deposit] => ft.inputs[i];
      deposit++;
    };
    for (Integer i = 0; i<otherHalf; i++) {
      inputs[deposit] => st.inputs[i];
      deposit++;
    };
    ft.output => base.inputs[0];
    st.output => base.inputs[1];
    return Combiner( <Connection[ ] inputs = inputs> =>
                     <Connection output = base.output> );
  }

  register makeMwayCombiner;
}
```

Example 29: wiki/MeetingMinutes/Architecture/DISPEL/MakeTreeOfCombiners

An example of makeMwayCombiner(4, Amerge)