新技术专题

Web服务组合

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What are some everyday services?

- ✓ Transportation

  Trains, planes, delivery
- ✓ Infrastructure

  Communications, electricity, water
- ✓ Government

  Police, fire, mail
- ✓ Entertainment

  Television, movies, concerts
- ✓ Professional Services

  Doctors, lawyers, skilled craftspeople, project management, education

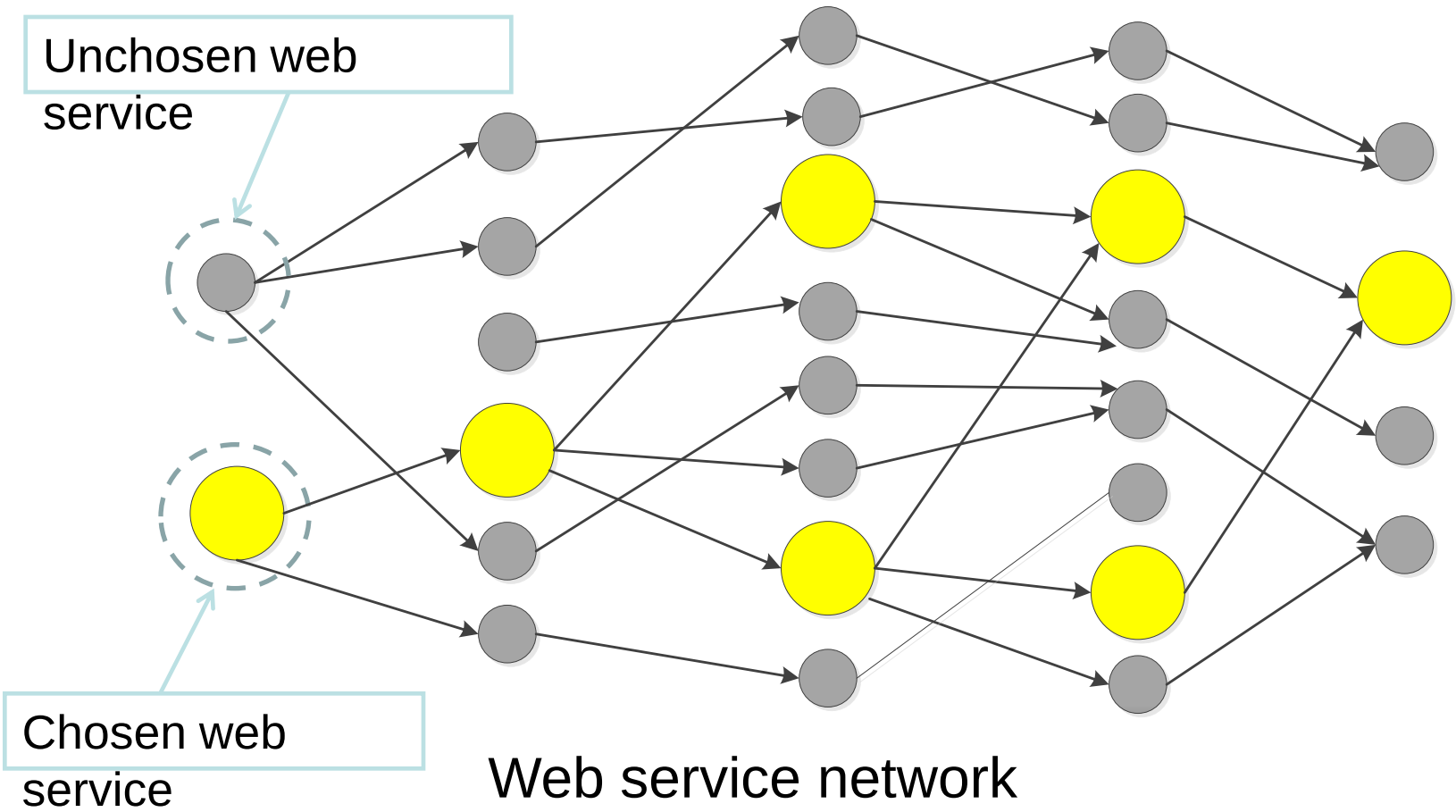
What are Web Services?

封装的业务

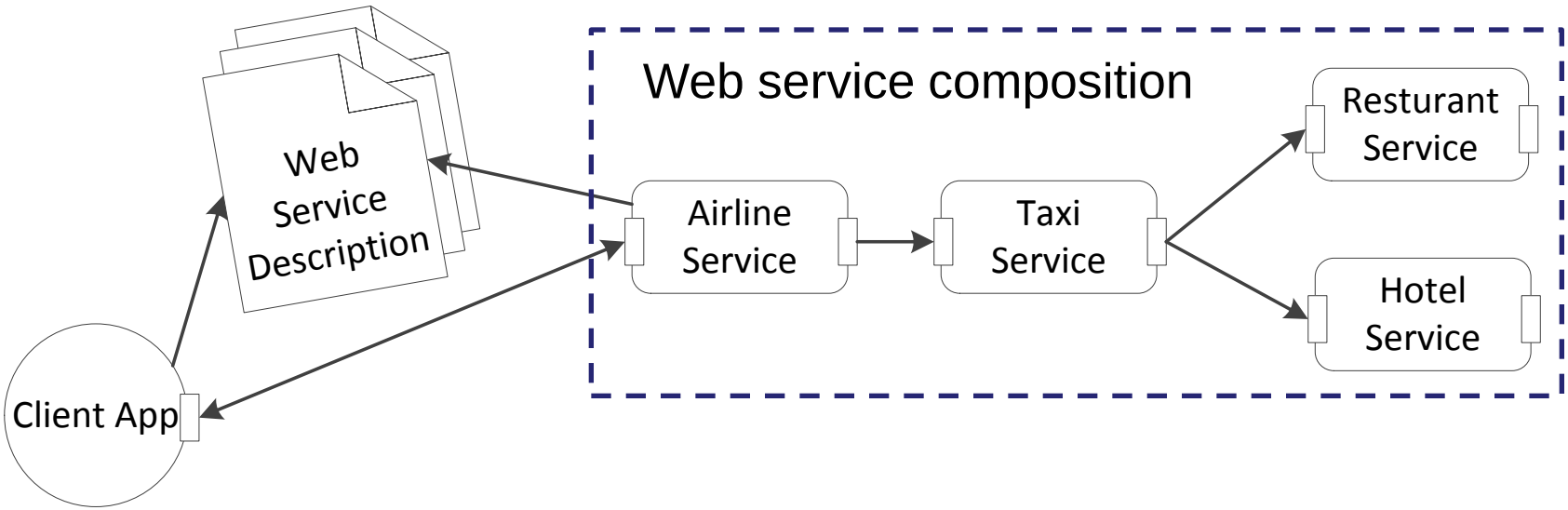
Web services perform **encapsulated business functions** such as:

1. a self-contained business task – a funds withdrawal or funds deposit service;
2. a full-fledged business process – the automated purchasing of office supplies;
3. an application – a life insurance application or demand forecasts and stock replenishment; or
4. a service-enabled resource – access to a particular back-end database containing patient medical records.

引言


Unchosen web service
Chosen web service
Web service network

引言



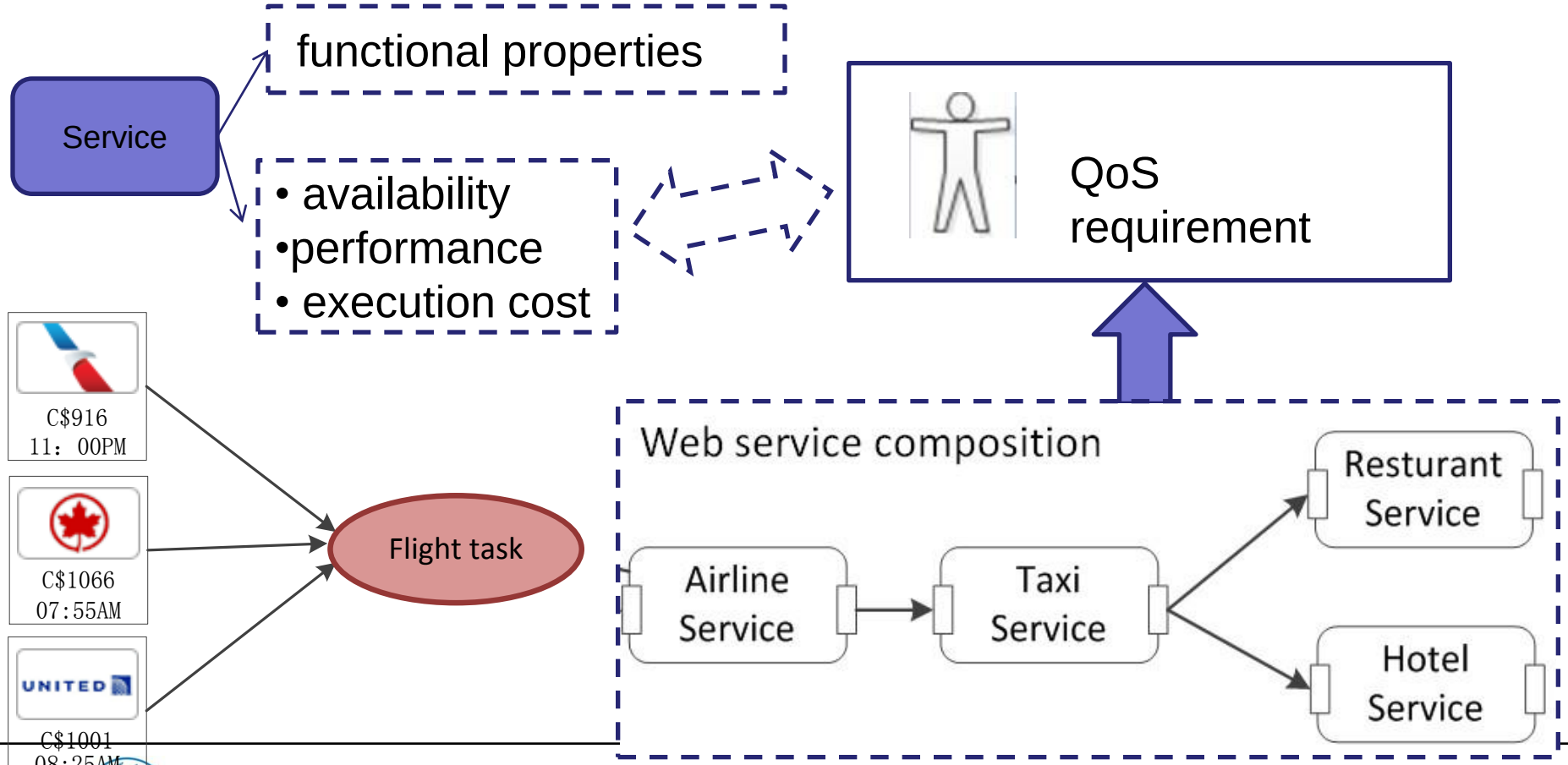
Web Service Composition (WSC)

Combine different web services together to fulfill users' complex requirements

引言

QoS (Quality of Service)

Non-functional properties of services



研究动机

Web Service Composition

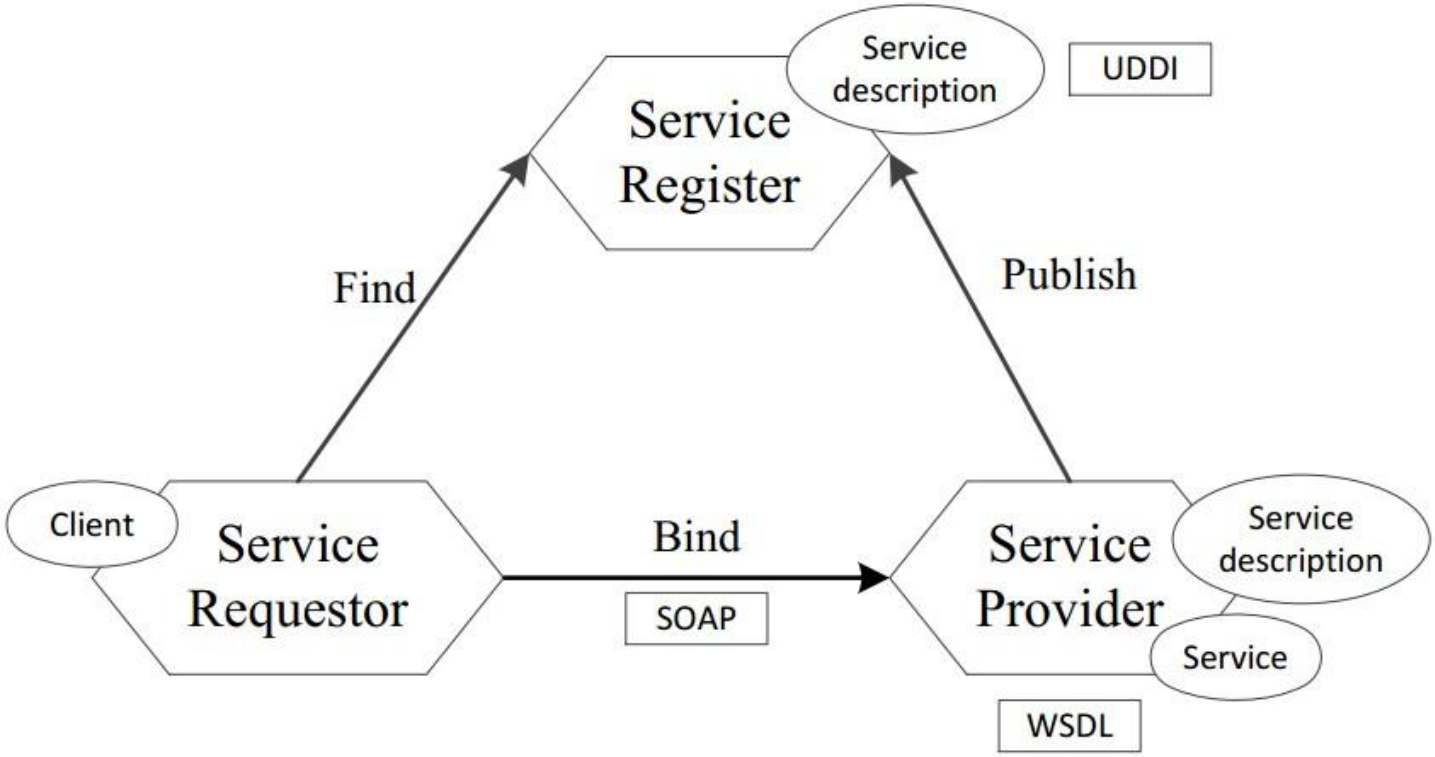
- Enterprises may focus on core services and find other services on Internet
- A single service can hardly address complex business requirement
- Searching an optimal solution is computationally demanding work

Problem statement：

1. Obtain the service information

2. Solve the service composition problem, the solution should fulfill users' functional requirement as well as their QoS preference

基础知识



Web service architecture

引言

UDDI: Universal Description, Discovery, and Integration

- *Service registries and discovery.*

SOAP: Simple Object Access Protocol

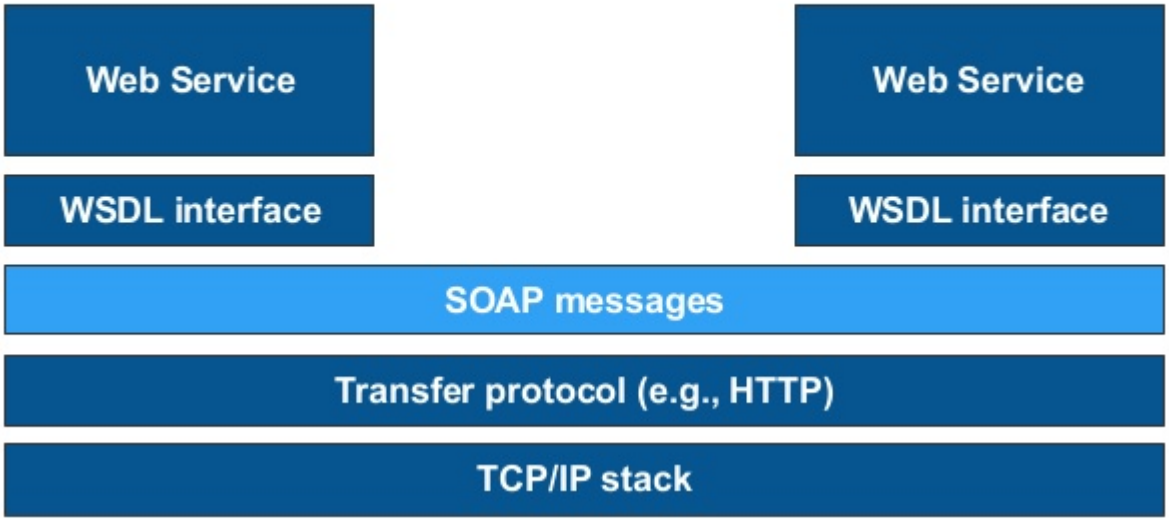
- A messaging protocol used to exchange messages over networks.
- An XML-based protocol for exchanging messages.
- A SOAP method is simply an HTTP request and response that complies with the SOAP encoding rules.

WSDL: Web Service Description Language

- WSDL is an XML-based specification schema for describing a web service.

SOAP

SOAP is a network application protocol that is used to transfer messages between service instances, described by WSDL interfaces.



XML

HTML

XML is a markup language for text documents / textual data

XML allows to define languages (“applications”) to represent text documents / textual data

A Simple XML Document

```
<article>
  <author>Gerhard Weikum</author>
  <title>The Web in Ten Years</title>
  <text>
    <abstract>In order to evolve...</abstract>
    <section number="1" title="Introduction">
      The <index>Web</index> provides the universal...
    </section>
  </text>
</article>
```

Start Tag

End Tag

Element

Content of the Element (Subelements and/or Text)

book.xml

```xml
<?xml version="1.0" encoding="utf-8"?>
<books>
  <book>
    <author>Margaret Mitchell</author>
    <title>Gone with the wind</title>
    <category>Novel</category>
    <edition>3</edition>
  </book>
  <book>
    <author>Jennifer L. Armstrong</author>
    <title>A Good Man</title>
    <category>Novel</category>
    <edition>2</edition>
  </book>
  <book>
    <author>Jennifer L. Armstrong</author>
    <title>Death Among the Dinosaurs</title>
    <category>Novel</category>
    <edition>2</edition>
  </book>
</books>
```

XML 声明:版本&编码

嵌套元素

根元素

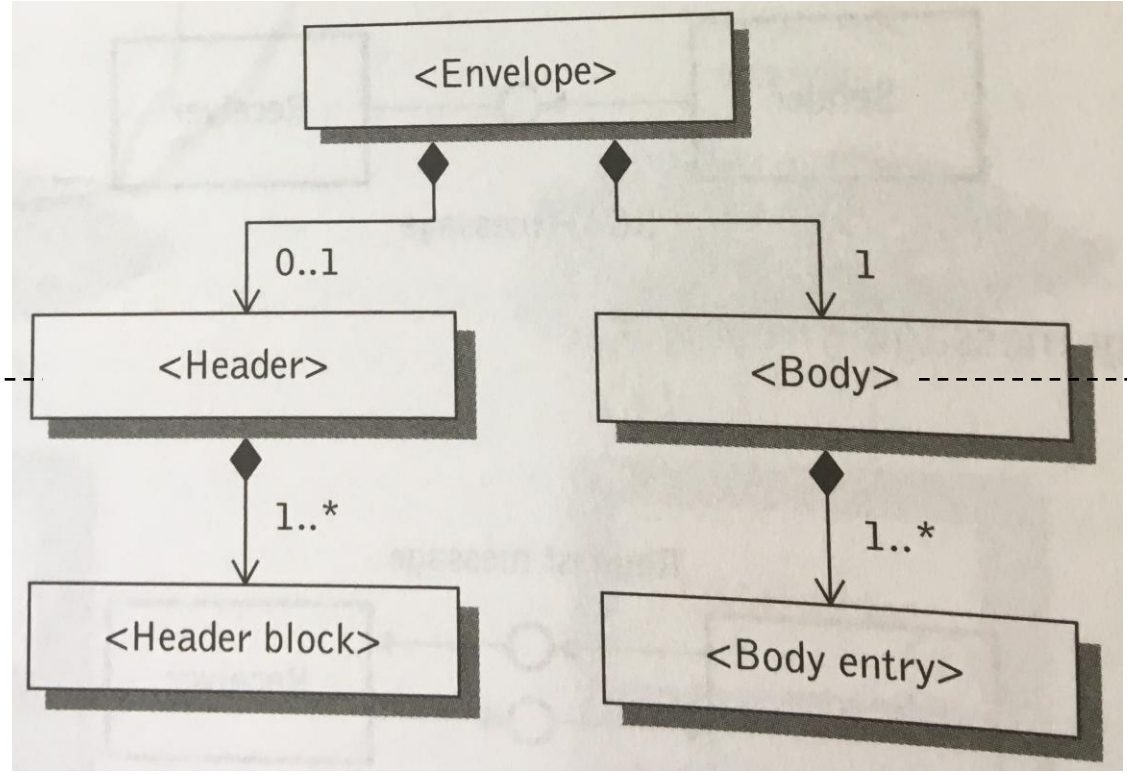
XML

Services.wsdl | 1.xml

```xml
<?xml version="1.0" encoding="UTF-8"?>
<BillingInformation>
<Name>Plastic Products</Name>
<BillingDate>2017-09-04</BillingDate>
<Address>
    <Street>158 Edward st.</Street>
    <City>Montreal</City>
    <Province>Quebec</Province>
    <Postcode>H3H2N3</Postcode>
</Address>
</BillingInformation>
```

Structure of a SOAP message

文件发送地、始发、签名等



封装：
消息中的内容以及如何处理消息

调用和响应信息

Example of SOAP body

```
<env:Envelope
 xmlns:SOAP="http://www.w3.org/2003/05/soap-envelope">

    <env:Header>
          <tx:Transaction-id
          xmlns:t="http://www.transaction.com/transactions"
              env:mustUnderstand='1'>
              512
    </env:Header>
    <env:Body>
          <po:PurchaseOrder oderDate="2004-12-02"
          xmlns:m="http://www.plastics_supply.com/POs">
          <po:from>
            <po:accountName>   RightPlastics   </po:accountName>
                <po:accountNumber>   PSC-0343-02  </po:accountNumber>
          </po:from>
          <po:to>
            <po:supplierName>  Plastic Supplies Inc.  </po:supplierName>
            <po:supplierAddress>  Yara Valley Melbourne  </po:supplierAddress>
          </po:to>
          <po:product>
              <po:product-name> injection molder </po:product-name>
              <po:product-model> G-100T </po:product-model>
              <po:quantity> 2 </po:quantity>
          </po:product>
          </ po:PurchaseOrder >
    </env:Body>
</env:Envelope>
```

WSDL:
Web Service Description Language

<definitions>:Root WSDL Element

<types>: What data types will be transmitted?

<message>: What message will be transmitted?

<portType>: What operations (functions) will be supported?

<binding>: How will the messages be transmitted on the wire? What SOAP-specific details are there?

<service>: Where is the service located?

Structure of WSDL

Services.wsdl: service information

```
<!-- Service W1 -->
    <service name="W1">
        <port binding="service:W1Binding" name="W1P">
            <soap:address location="http://www.ws-challenge.org/W1"/>
        </port >
    </service >
    <binding name="W1Binding" type="service:W1PT">
        <soap:binding style="rpc" transport="http://schemas.xmlsoap.org/soap/http"/>
        <operation name="W1op">
            <soap:operation soapAction ="http://www.ws-challenge.org/W1/W1op" />
            <input >
                <soap:body use="literal"/>
            </input >
            <output >
                <soap:body use="literal"/>
            </output >
        </operation >
    </binding >

    <portType name="W1PT">
        <operation name="W1op">
            <input message ="service:W1RequestMessage"/>
            <output message ="service:W1ResponseMessage"/>
        </operation >
    </portType >

    <message name="W1RequestMessage">
        <part element ="service:A" name="AP"/>
        <part element ="service:B" name="BP"/>
        <part element ="service:C" name="CP"/>
    </message >
    <message name="W1ResponseMessage">
        <part element ="service:J" name="JP"/>
    </message >
```

Challenge.wsdl: request & goal

```
<message name="WCQRequestMessage">
    <part element ="service:A" name="AP"/>
    <part element ="service:B" name="BP"/>
    <part element ="service:C" name="CP"/>
</message >
<message name="WCQResponseMessage">
    <part element ="service:D" name="DP"/>
</message >
<!-- Data types -->
<types>
<xsd:schema targetNamespace="http://www.ws-challenge.org/WSC08Services/" >
    <xsd:element name="A" type="xsd :string "/>
    <xsd:element name="B" type="xsd :string "/>
    <xsd:element name="C" type="xsd :string "/>
    <xsd:element name="D" type="xsd :string "/>
</xsd:schema>
 </types>
```

基础知识

A web service can be seen as a blackbox:

(w_{in}, w_{out}, Q)

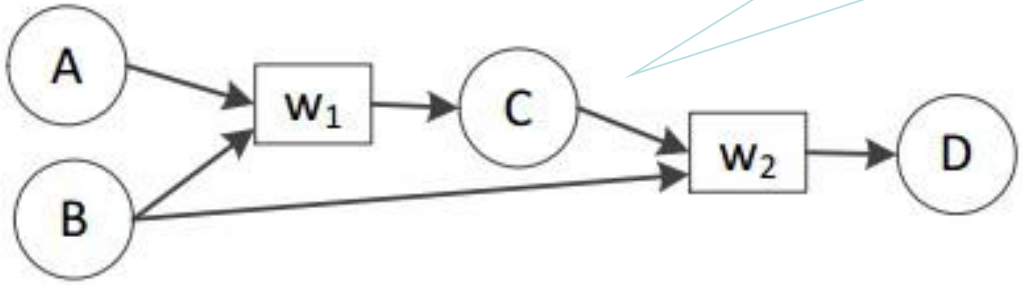
- w_{in} -- input parameters
- w_{out} -- output parameters
- Q -- QoS criteria

基础知识

A web service composition problem:

- (S, C_{in}, C_{out}, Q)
  - S -- services
  - C_{in} -- input parameters
  - C_{out} -- output parameters
  - Q -- QoS criteria

如果一个web服务的输出是另一个web服务输入的一部分，这两个web服务是可连接的



- $S=\{w_1, w_2\}$ $C_{in}=\{A, B\}$ $C_{out}=\{D\}$

基础知识

web服务的连接方式:

顺序连接(Sequence): $w_1;w_2; \ldots;w_n$

并行连接(Parallel): $w_1||w_2||...||w_n$

基础知识

Cost (C): 服务的价格 $C(w_1;w_2;\ldots;w_n) = C(w_1||w_2||\ldots||w_n) = \sum C(w_i)$

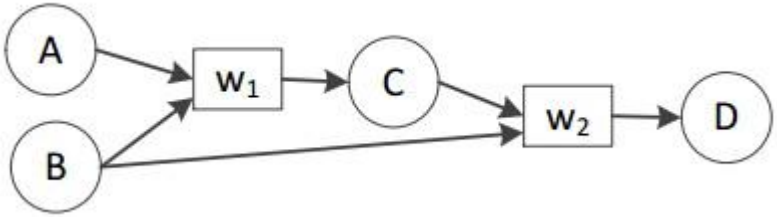
Response time (R): 收到询问消息与传送回复消息的时间间隔(单位:毫秒)

$R(w_1;w_2;\ldots;w_n) = \sum R(w_i)$

$R(w_1||w_2||\ldots||w_n) = \max R(w_i)$

Throughput (T): 单位时间内通过信道成功交付的消息的数量

$T(w_1;w_2;\ldots;w_n) = T(w_1||w_2||\ldots||w_n) = \min T(w_i)$



Ws_id	Service	Inputs	Outputs	Response	Throughput
1	w_1	A,B	C	25	120
2	w_2	B,C	D	30	200

数据库存储

Method of choice?

Use “join” operator to find compositions

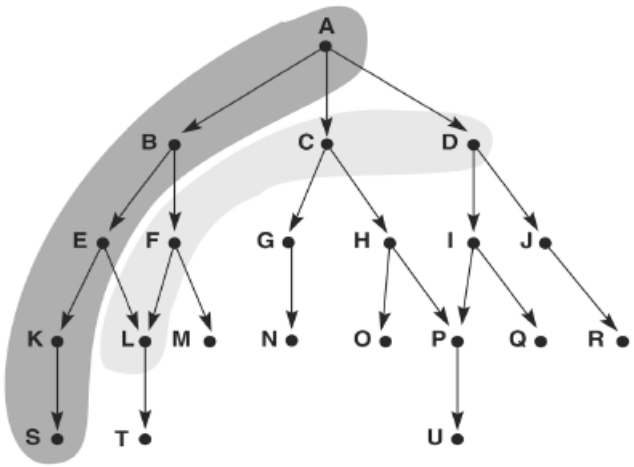
Compose SQL query to search in database for a solution

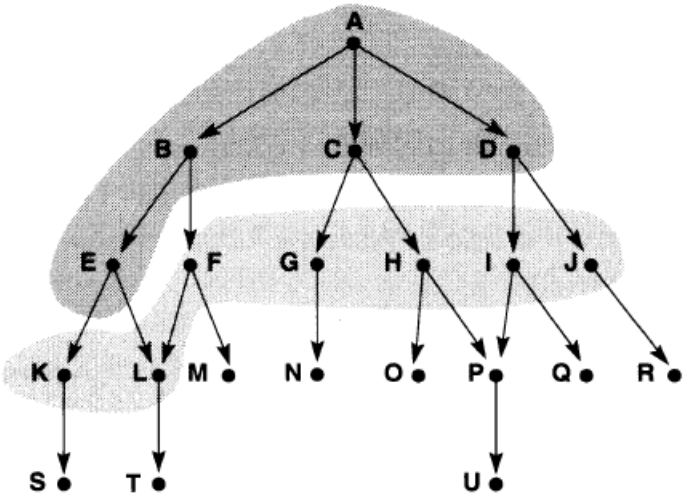
Motivation

- Take advantage of large space available in database.
- When a user query comes, we compose SQL queries to search in the database for solutions with optimized QoS.

深度优先 & 宽度优先搜索

- Determine order for examining states
- ✓ Depth-first:
  - visit children before siblings
- ✓ Breadth-first:
  - Visit siblings before children (level by level)





启发式搜索

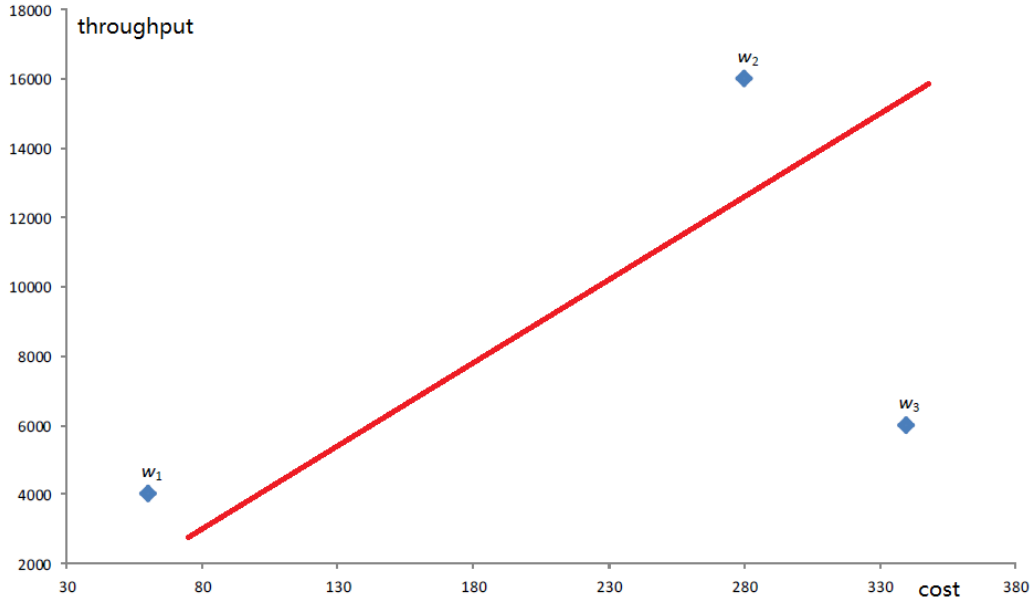
启发式搜索(Heuristically Search)：

利用问题拥有的启发信息来引导搜索，达到减少搜索范围、降低问题复杂度的目的。

Service	Cost	Throughput
w_1	190	6000
w_2	200	12000
w_3	220	8000

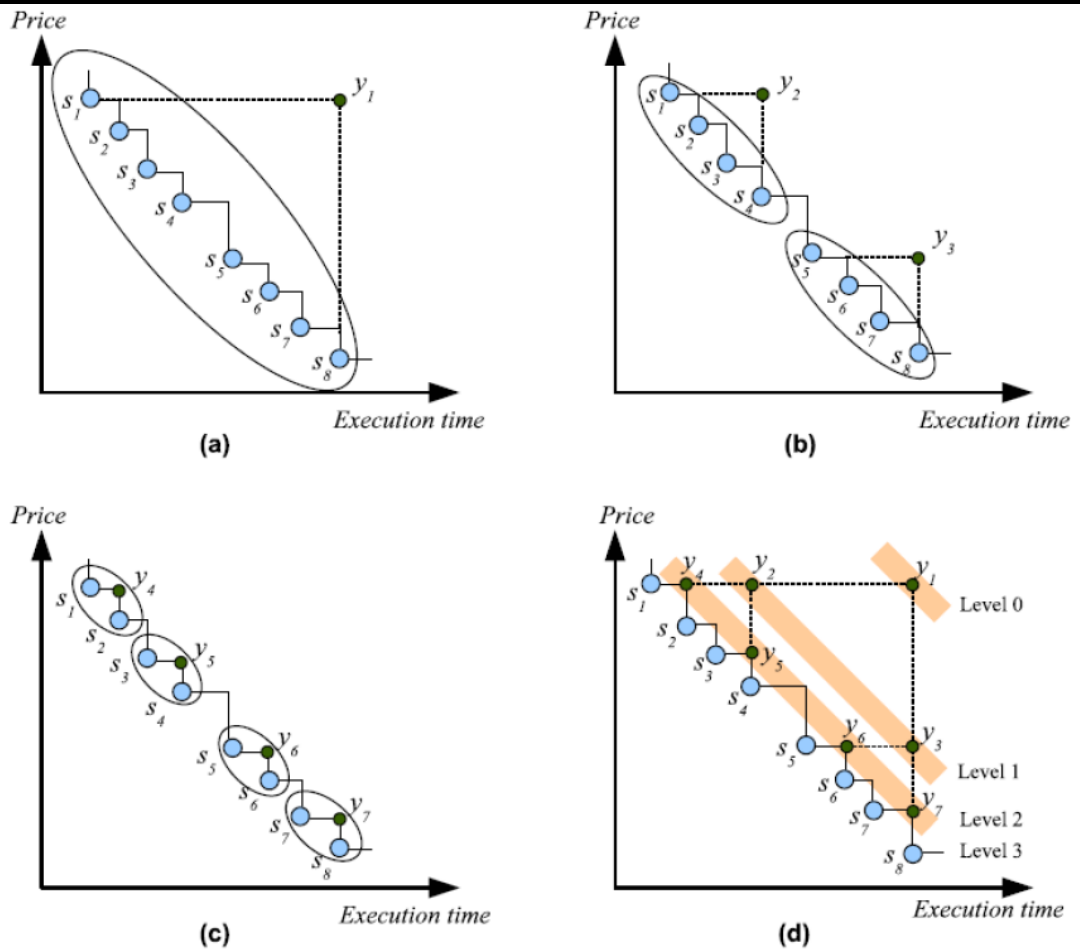
Skyline操作

Skyline操作是指从海量数据中选择一组数据，该组数据中的任一数据在所有标准方面的表现都不比其它数据差，且至少在一个标准上的表现比其它数据好。



skyline={w_1, w_2}

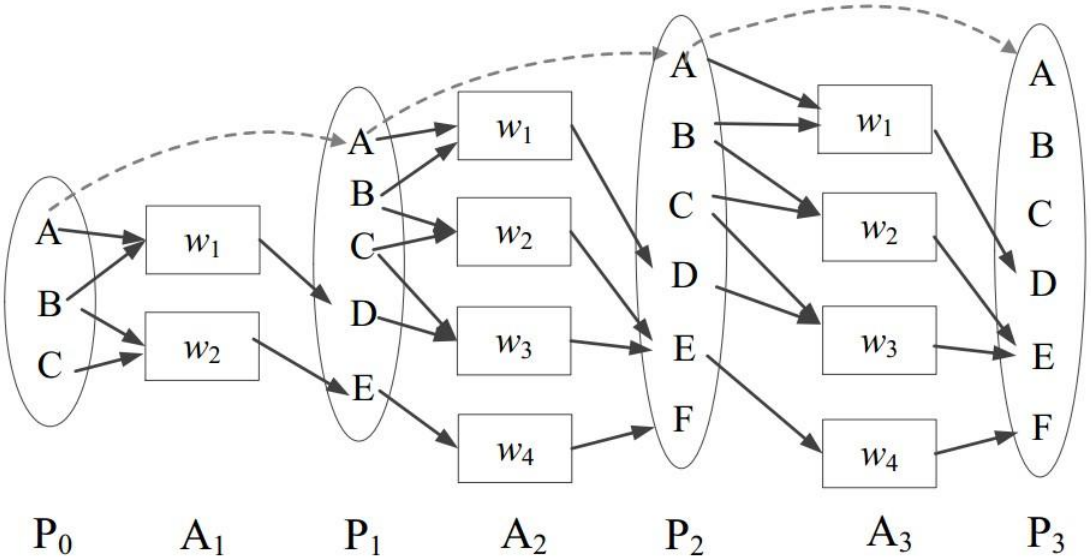
Skyline操作



分治策略

规划图（planning graph）方法

$C_{in}=\{A, B, C\}$
$C_{out}=\{F\}$



Most widespread: planning
Oh et al. (2006) Yan et al. (2009)
Kuzu et al. (2012)

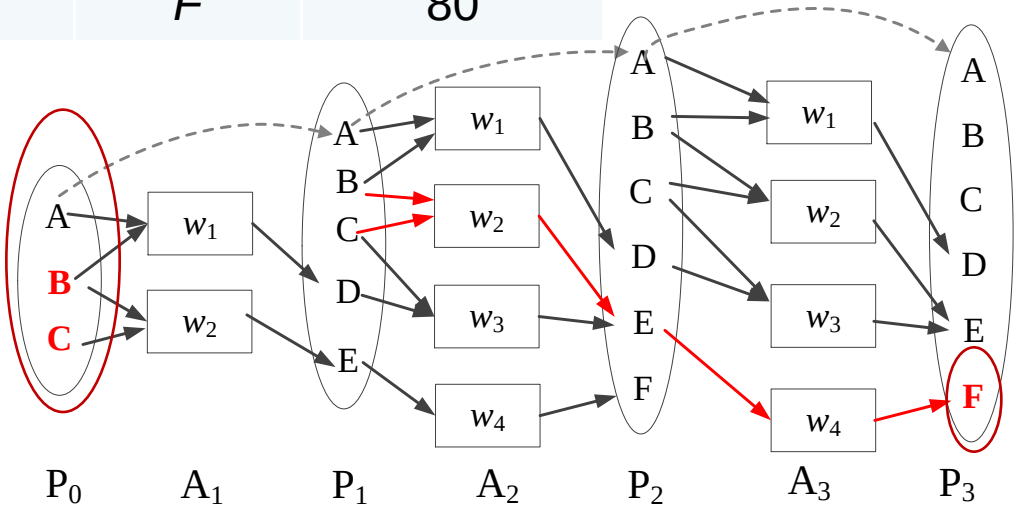
Graphpan method：

a) Forward expand: builds a planning graph from initial states to goal
b) Backward search: retrieves a solution

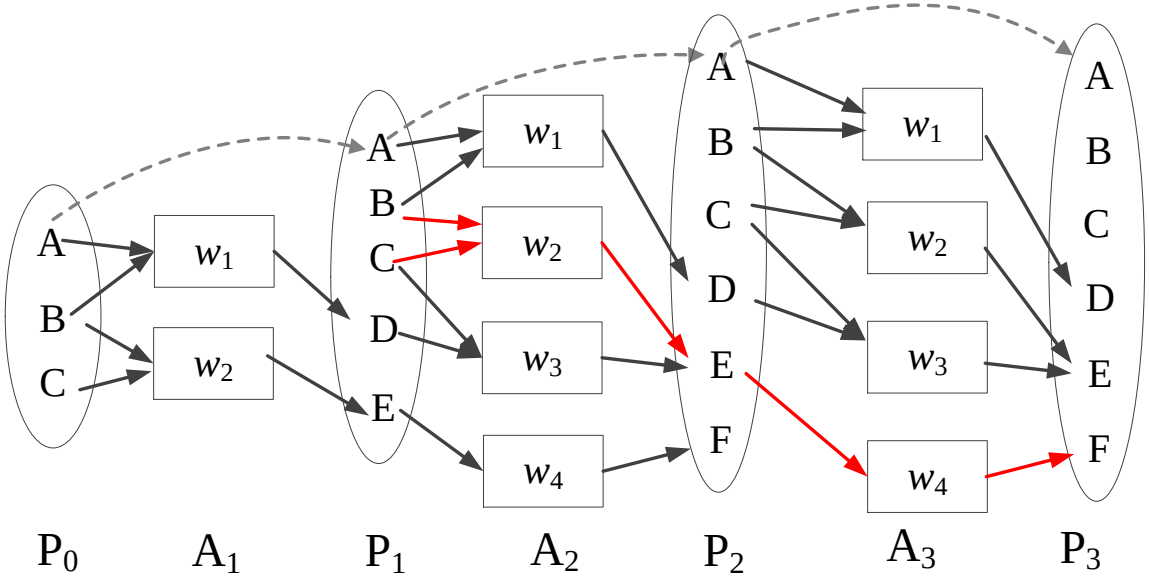
规划图方法

Service	Inputs	Outputs	Response time(*ms*)
w_1	*A, B*	*D*	100
w_2	*B, C*	*E*	200
w_3	*C, D*	*E*	30
w_4	*E*	*F*	80

$C_{in}=\{A, B, C\}$
$C_{out}=\{F\}$



规划图方法



solution = $w_2 \longrightarrow w_4$

Response time:280 *ms*

作业：

1.确定web服务组合问题：Challenge.wsdl 文件

2.确定服务提供者提供的web服务：Services.wsdl文件

3.画出规划图（planning graph）

4.找到一条解路径，要求web服务数最少