PRIN 2007: D-ASAP project

Roma “Tor Vergata” Unit

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Name	**Effort** (m/y)
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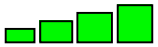
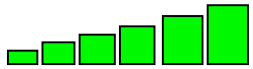
… others …	…

Our involvement in D-ASAP WP's

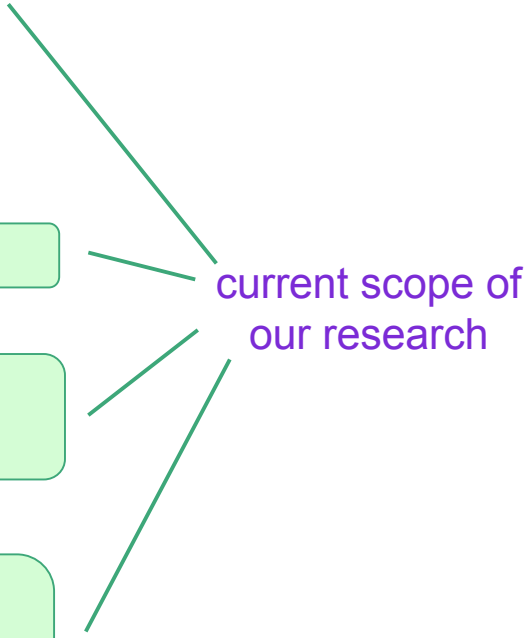
- WP 1  , WP 2  , WP 5 
  - (+ WP0 and WP6)

- general framework : design of adaptable systems

- our focus is on the *Service Oriented* (SOA) domain
  - architectural features
    - applications built using loosely coupled services
    - dynamic *discovery*, *selection* and *composition*
      - » different services with same functionality and different QoS/cost
  - contractually specified QoS/cost requirements: *Service Level Agreement* (SLA)
    - *provider* role, *requester* role
    - both roles in case of composite service

Adaptation of a SOA system

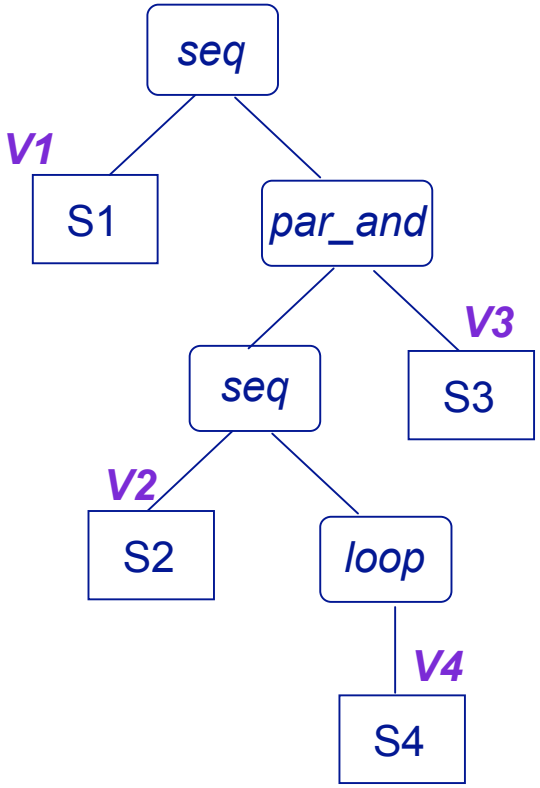
- problem dimensions
  - composite service model
    - structured workflow
    - unstructured workflow
    - mix
  - service demand model
    - single request
    - flow of requests
  - kind of adaptation
    - dynamic service selection
    - dynamic workflow restructuring
  - adaptation scope
    - single system
    - multiple systems
      - » centralized authority
      - » multiple cooperative authorities
      - » multiple non-cooperative authorities



our SOA system model

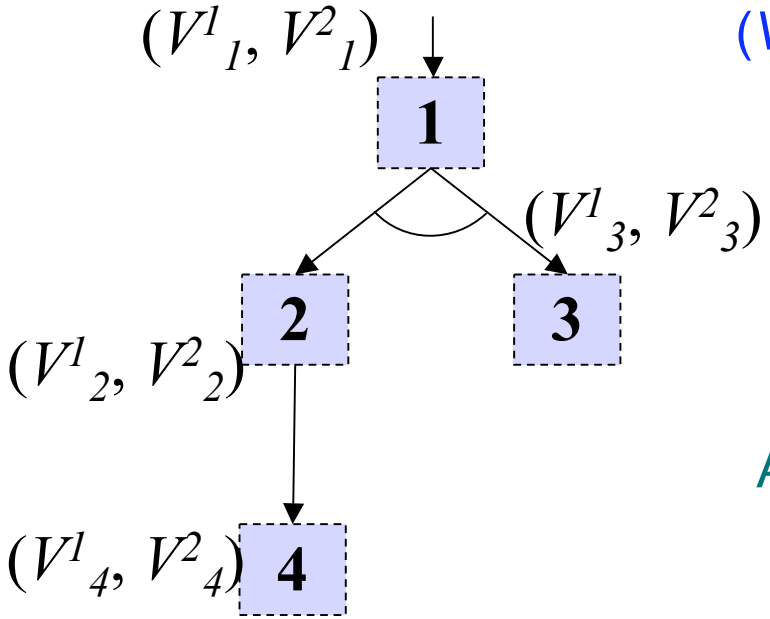
- service model : composite service
- functional model : “structured” workflow
  - S ::= S1 | S2 | ... | S*n* | *seq*(S^+) | *loop*(S) | *sel*(S^+) | *par_and*(S^+) | *par_or*(S^+)
    - S, S*i* : *abstract service*; S^+ : set of one or more *abstract services*
    - representative enough?
      - » other control structures
      - » other kinds of control (e.g., link-based)
- abstract model : labeled syntax tree
  - node S*i* labeled by V*i* : random variable indicating the number of visits to that node (utilization profile for a single client request)
    - stochastic setting (probabilistic QoS guarantees / SLA model)
    - V*i* and V*j* are generally non independent

```
S1;
par_and {{S2;
          loop {S4}
          };
          S3;
        }
```



A conceptual model for the adaptation of SOA systems (1)

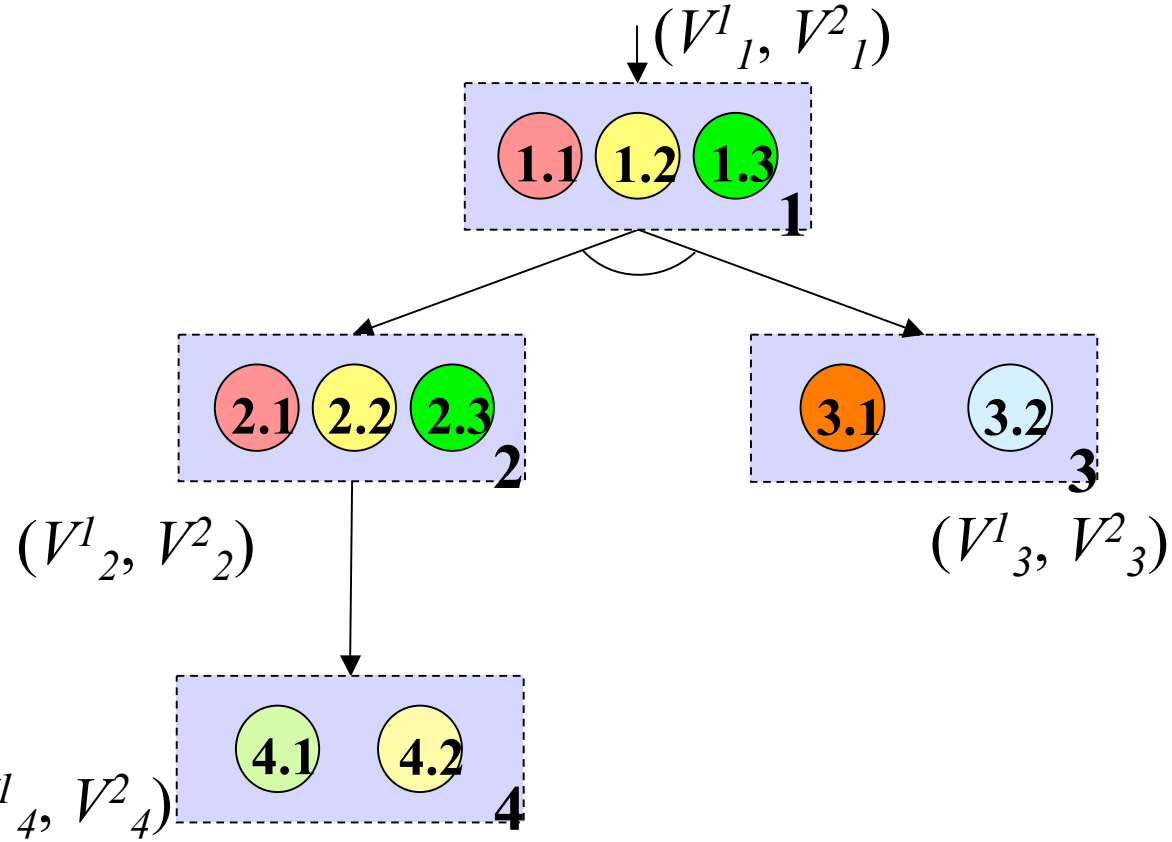
- Graph macro-node: an ***abstract* service** 
- Multi-class usage profile : number of visits (invocations) for each abstract service S*i*, for different classes of users: (V^1_i … V^m_i)



A graph for 2 service classes (*m*=2)

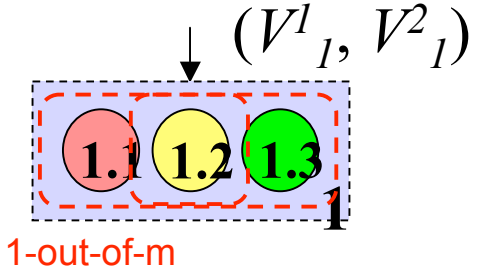
A conceptual model for the adaptation of SOA systems (2)

- Candidate ***concrete* services** represented inside each graph macro-node
  - pool of pre-identified candidate providers
  - each concrete service has known QoS attributes
    - negotiated / monitored



A conceptual model for the adaptation of SOA systems (3)

- kind of adaptation we consider
  - *service selection*: for an abstract service ***i***, select **one** concrete service ***i.j*** out of the set {***i.1*** , ***i.2*** , … }
  - *workflow restructuring*: for an abstract service ***i***, select **two or more** concrete services ***i.j*** out of the set {***i.1*** , ***i.2*** , … }, and use them according to some *spatial redundancy* paradigm
    - sequential retry, 1-out-of-m redundancy, majority voting, …
    - "local" workflow restructuring
      - » mainly for dependability improvement (but also performance in the case of 1-out-of-m)



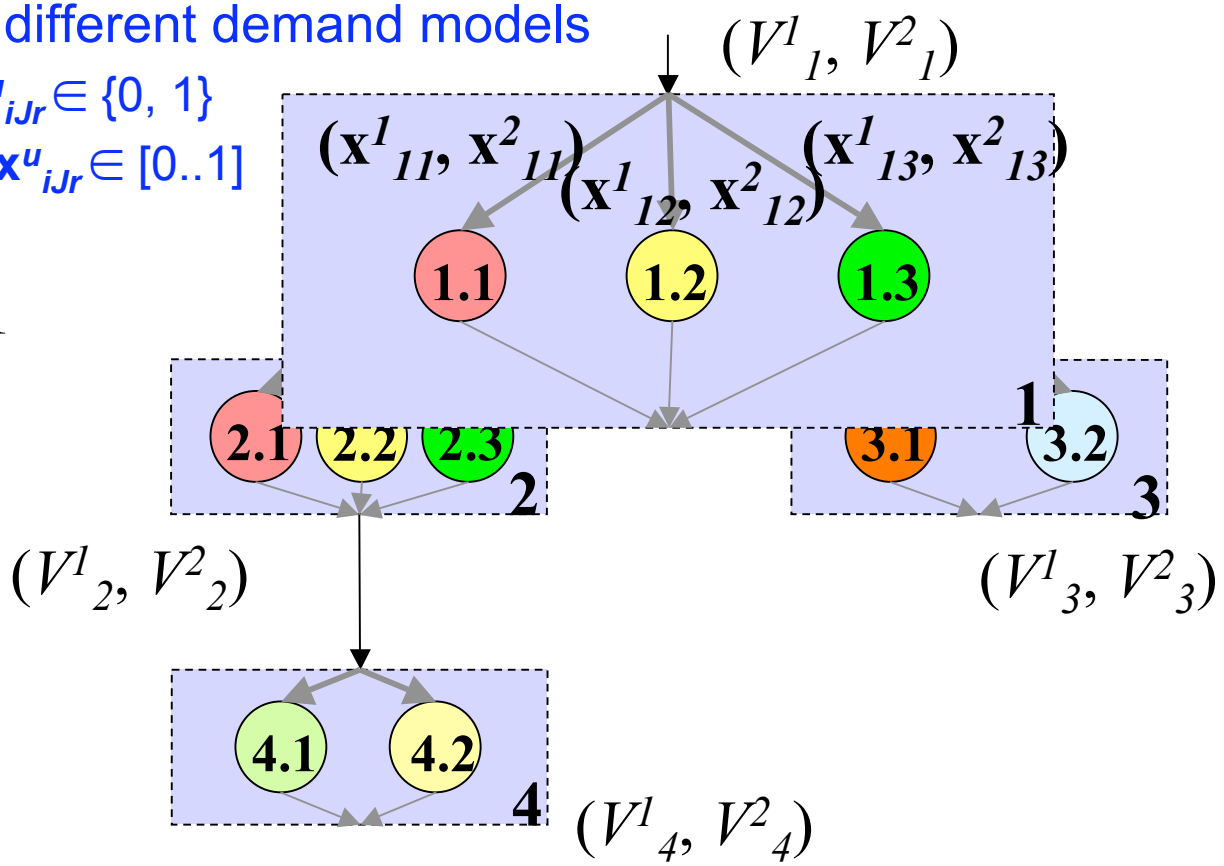
- modeled as :
  - ***i*** → ***i.J*** x *SRpar*
    - ***i.J*** ⊆ {***i.1*** , ***i.2*** , … }
    - *SRpar* = {Null, SeqRet, 1-of-m, MajVot, … }
  - | ***i.J*** | = 1 ⇒ service selection
  - | ***i.J*** | > 1 ⇒ workflow restructuring

A conceptual model for the adaptation of SOA systems (4)

- "control variables" $\mathbf{x}^{u}_{iJr}$ used to model the selection of a given adaptation mechanism
  - $\mathbf{x}^{u}_{iJr}$ refers to the selection of the set of concrete services ***i.J*** and redundancy mechanism ***r*** for the service class ***u*** (to implement the abstract service ***i***)

- range of values for different demand models
  - single request: $\mathbf{x}^{u}_{iJr} \in \{0, 1\}$
  - flow of requests: $\mathbf{x}^{u}_{iJr} \in [0..1]$
  - constraint:

$$\sum_{Jr} x^{u}_{iJr} = 1$$



Using the conceptual model in D-ASAP

- in collaboration with Raffaela Mirandola …

- **WP 5**: the conceptual model as the basis for the definition of an optimization problem whose solution drives the adaptation
  - QoS constraints and goals based on average values
    - higher moments?
  - adaptation triggering
    - suggestions from control theory?
  - implementation issues
    - architecture of an adaptable SOA system
    - mechanisms for dynamic workflow restructuring
  - other kinds of adaptation?
    - e.g., changing the pool of candidate providers

Constrained multi-criteria optimization problem

$$\text{Minimize } F(\mathbf{x})$$
$$\text{subject to } Q^{\alpha}(\mathbf{x}) \leq Q^{\alpha}_{max} \quad Q^{\beta}(\mathbf{x}) \geq Q^{\beta}_{min} \quad \text{(QoS constraints)}$$
$$\mathbf{x} \in A \quad \text{(Functional constraints)}$$

- **WP 2**: design and implementation of a simulator of an adaptable SOA system
  - definition of suitable testbeds
    - see recent paper at *ICSOC 2008*