CSE 601: Distributed Systems

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Architectural Styles

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Important styles of architecture for distributed systems:

- Layered architectures
- Object-based architectures
- Data-centered architectures
- Event-based architectures

Architectural Styles

Layered Architectures

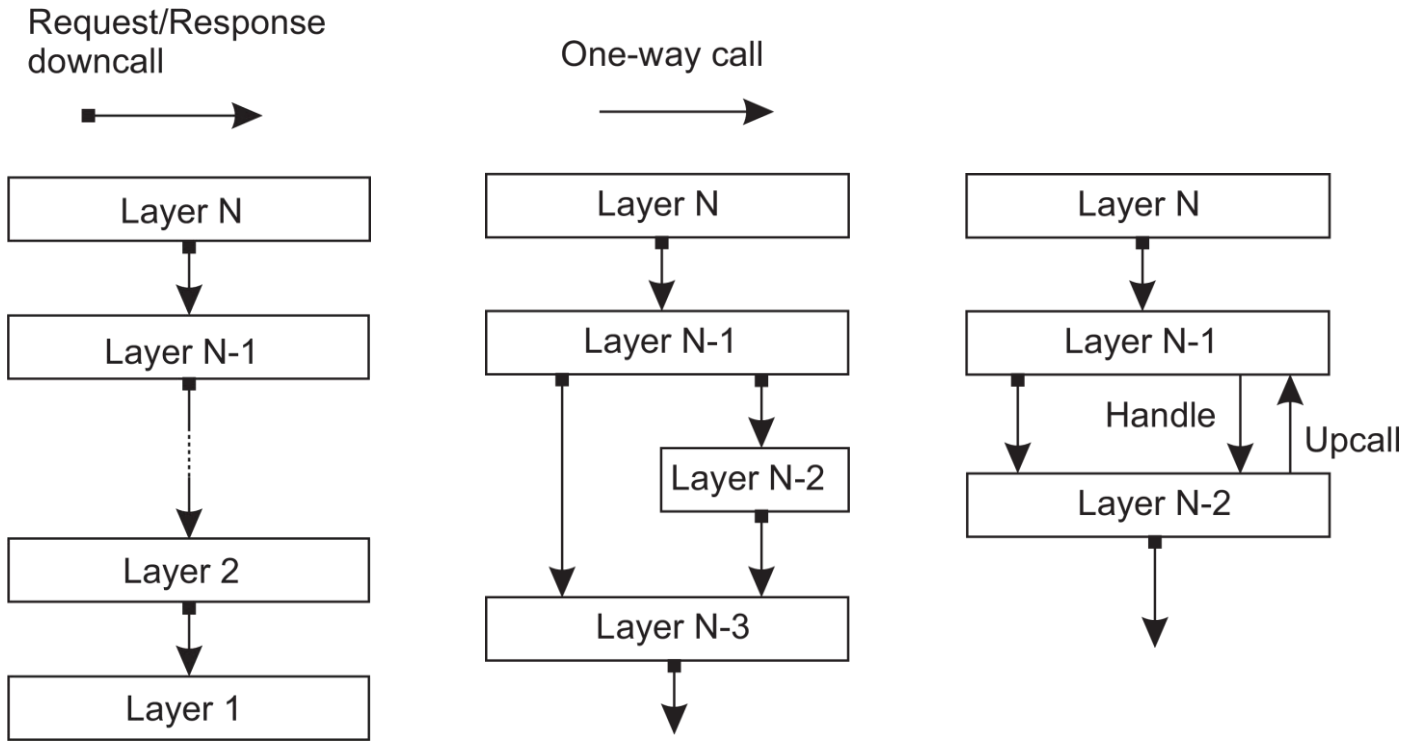
Layered Architectures

The basic idea for the layered style is simple:

- Components are organized in a layered fashion where a component at layer L_j can make a downcall to a component at a lower-level layer L_i (with $i < j$) and generally expects a response.

Layered Architectures

- Different Layered Architecture



(a) Pure layered organization

(b) Mixed layered organization

(c) Layered organization with upcalls

Layered Architectures

Pure Layered Organization:

- Only downcalls to the next lower layer are made.
- This organization is commonly deployed in the case of network communication.
  - In TCP IP, there are 5 layers. (application, transport, network, link, physical) and you can only talk to the next one, not N-2.
- Layer N-1 will provide an interface to N, and all communications must be conducted exclusively through this interface.

Layered Architectures

Mixed Layered Organization:

- Consider an application A (N-1) that makes use of a library L_{OS} (N-3) to interface to an operating system.
- At the same time, the application uses a specialized mathematical library L_{math} (N-2) that has been implemented by also making use of LOS (N-3)
- In this case, A is implemented at layer N-1, L_{math} at layer N-2, and L_{OS} which is common to both of them at layer N-3.

Layered Architectures

Layered organization with upcalls:

- A lower layer can make an upcall to its next higher layer.
- A typical example is when an operating system signals the occurrence of an event, to which end it calls a user-defined operation for which an application had previously passed a reference (typically referred to as a handle).
- N-1 is interested in event in N-2, so N-2 notifies N-1 that the event (handle) happened, using an upcall.

Application Layering

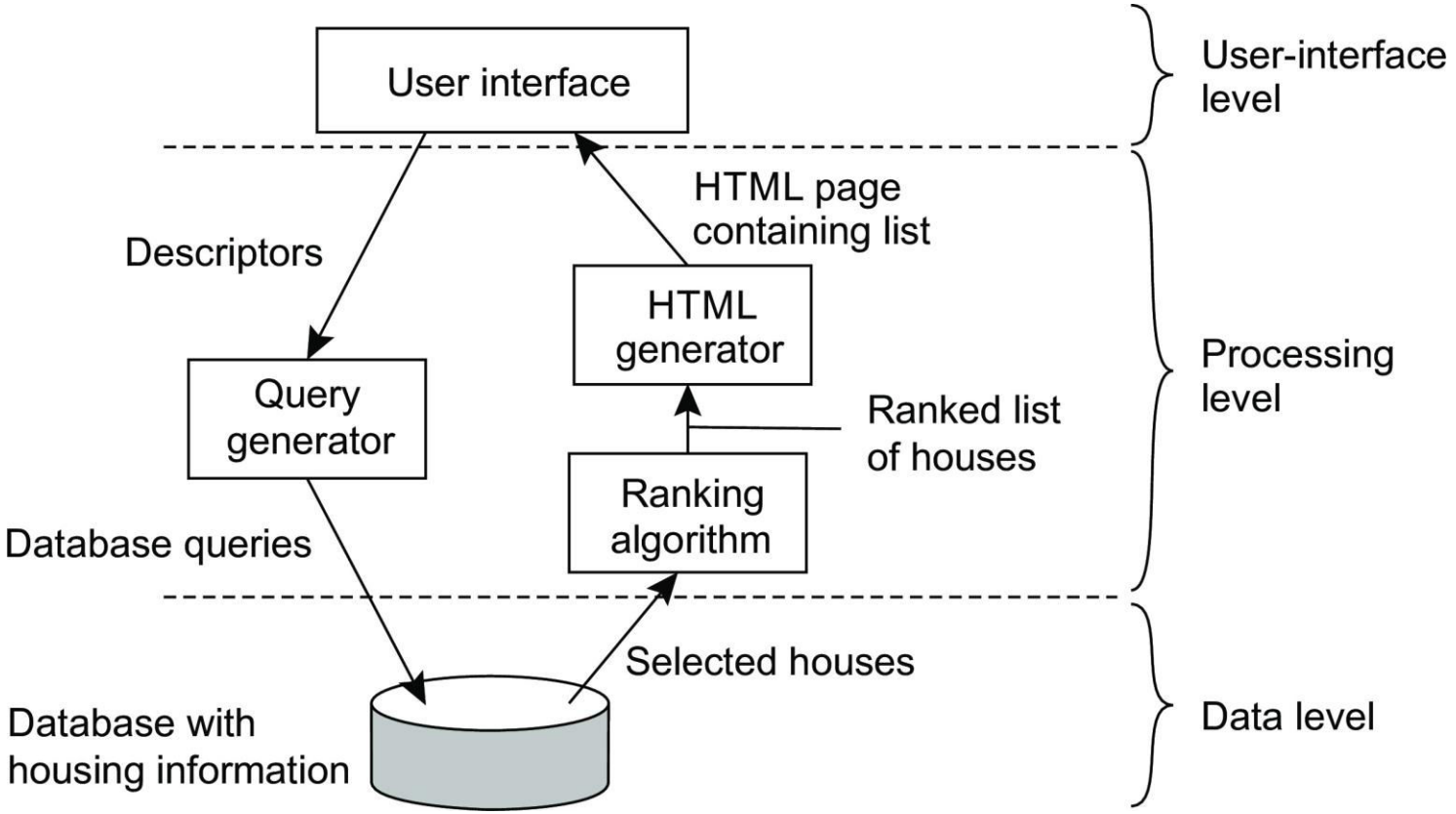
Traditional three-layered view

- **Application-interface layer (Presentation Layer)** contains units for interfacing to users or external applications.
- **Processing layer** contains the functions of an application, i.e., without specific data.
- **Data layer** contains the data that a client wants to manipulate through the application components.

This layering is found in many distributed information systems, using traditional database technology and accompanying applications.

Application Layering

- Example: A simple search engine

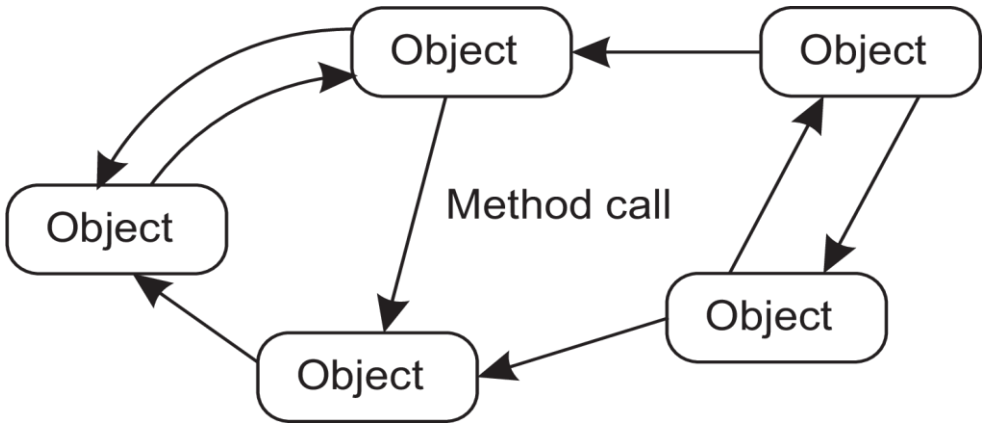


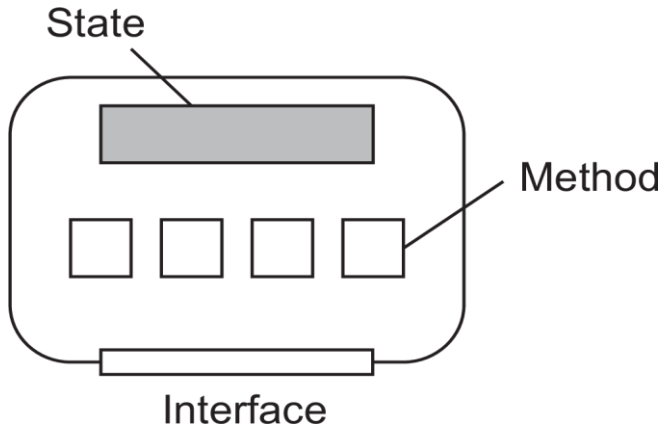
Architectural Styles

Object-based architectures

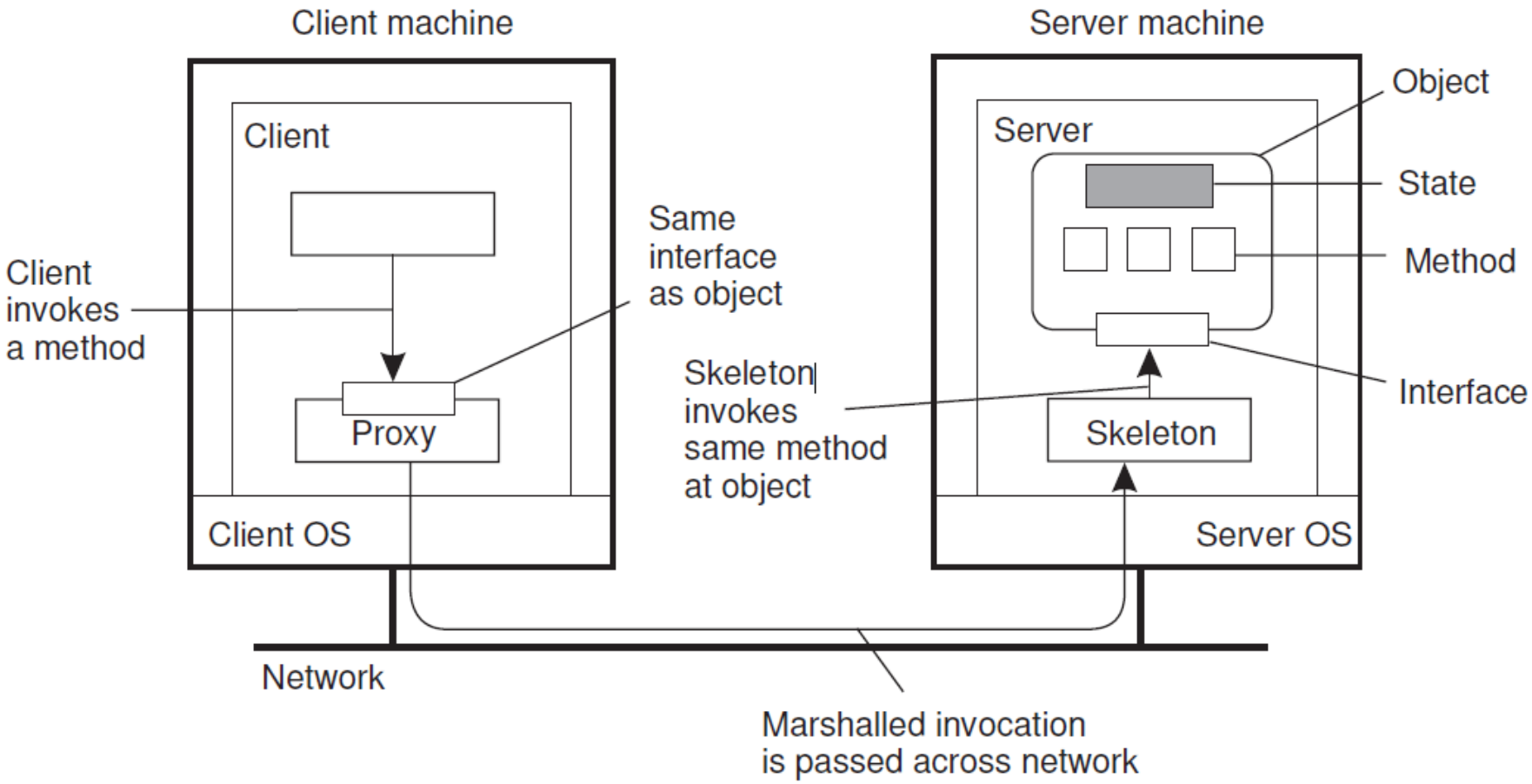
Object-based Architectures

- Components are objects, connected to each other through procedure calls. Objects may be placed on different machines; calls can thus execute across a network.
- Objects are said to encapsulate data and offer methods on that data without revealing the internal implementation.





Object-based Architectures



Common organization of a remote object with client-side proxy.