BEST JOBS IN AMERICA *Money/Payscale.com's list of great careers* 2010

Full List | High Pay | Job Growth | Quality of Life | Sectors

1. Software Architect

Recommend 2K

1 of 100 Next

Top 100 rank: 1
Sector: Information Technology

What they do: Like architects who design buildings, they create the blueprints for software engineers to follow -- and pitch in with programming too. Plus, architects are often called on to work with customers and product managers, and they serve as a link between a company's tech and business staffs.

What's to like: The job is creatively challenging, and engineers with good people skills are liberated from their screens. Salaries are generally higher than for programmers, and a typical day has more variety.

"Some days I'll focus on product strategy, and other days I'll be coding down in the guts of the system," says David Chaiken, 46, of Yahoo in Sunnyvale, Calif., whose current projects include helping the web giant customize content for its 600 million users. Even though programming jobs are moving overseas, the face-to-face aspect of this position helps cement local demand.

PHOTO: DAVID LAURIDSEN

Chaiken, a software engineer for more than two decades, relishes the more collaborative work.

What's not to like: You are often outside the management chain of command, making it hard to get things done.

Requirements: Bachelor's degree, and either a master's or considerable work experience to demonstrate your ability to design software and work collaboratively.

Material and some slide content from:
- Software Architecture: Foundations, Theory, and Practice

NFPs

Reid Holmes

Lecture 5 - Tuesday, Sept 27 2010.

NFPs

- NFPs are constraints on the manner in which the system implements and delivers its functionality.
  - E.g.,
    - Efficiency
    - Complexity
    - Scalability
    - Heterogeneity
    - Adaptability
    - Security
    - Dependability

FP vs NFP

- Products are sold based on their FPs.
  - e.g., Cell phone, Car, Tent.
- However, NFPs play a critical role in perception.
  - “This program keeps crashing”
  - “It doesn’t work with my [...]”
  - “It’s too slow”

Design guidelines for NFPs

- Provide guidelines that support various NFPs.
- Focus on architectural level:
  - Components
  - Connectors
  - Topologies

NFP: Efficiency

- Efficiency is a quality that reflects a system's ability to meet its performance requirements.
- Components:
  - Keep them "small".
  - Simple and compact interfaces.
  - Allow multiple interfaces to the same functionality.
  - Separate data from processing components.
  - Separate data from meta data.
- Connectors:
  - Carefully select connectors.
  - Be careful of broadcast connectors.
  - Encourage asynchronous interaction.
  - Be wary of location/distribution transparency.
- Topology:
  - Keep frequent collaborators "close".
  - Consider the efficiency impact of selected styles.

Multiple Interfaces

Distribution transparency

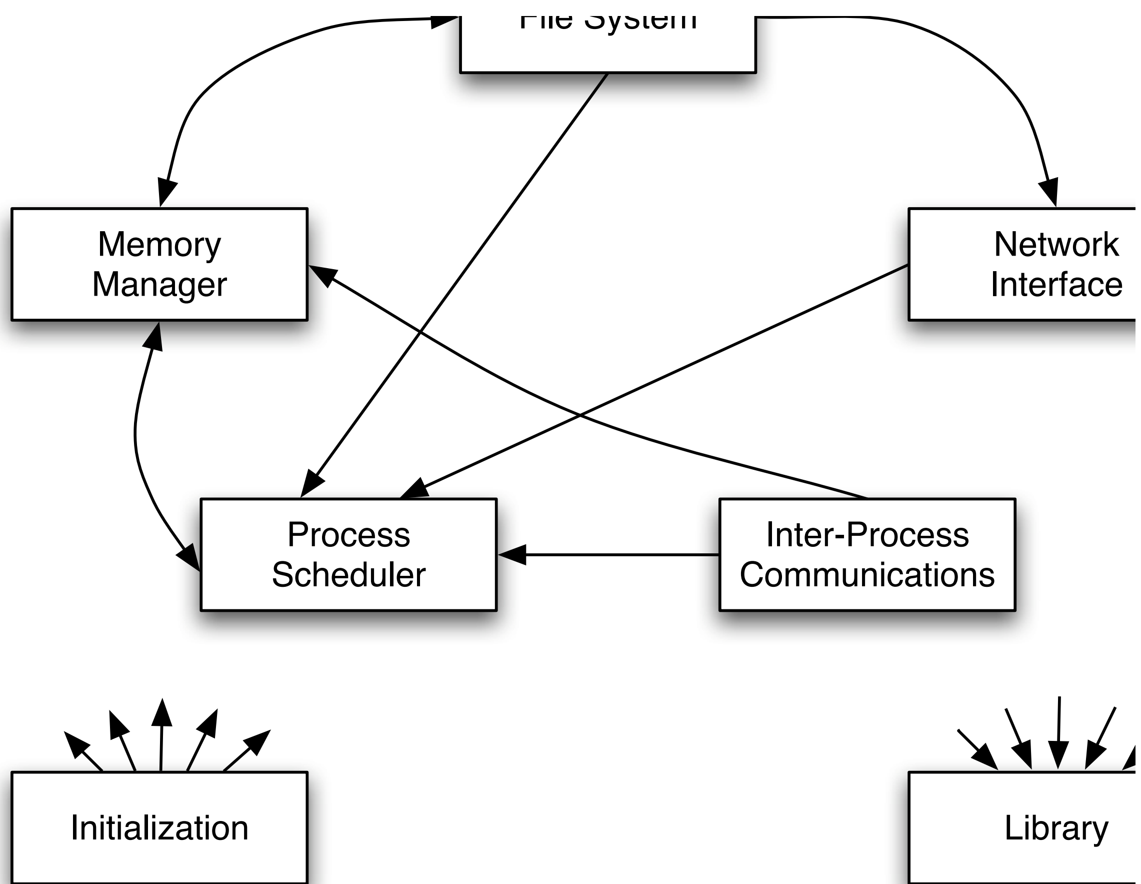
Topological distance

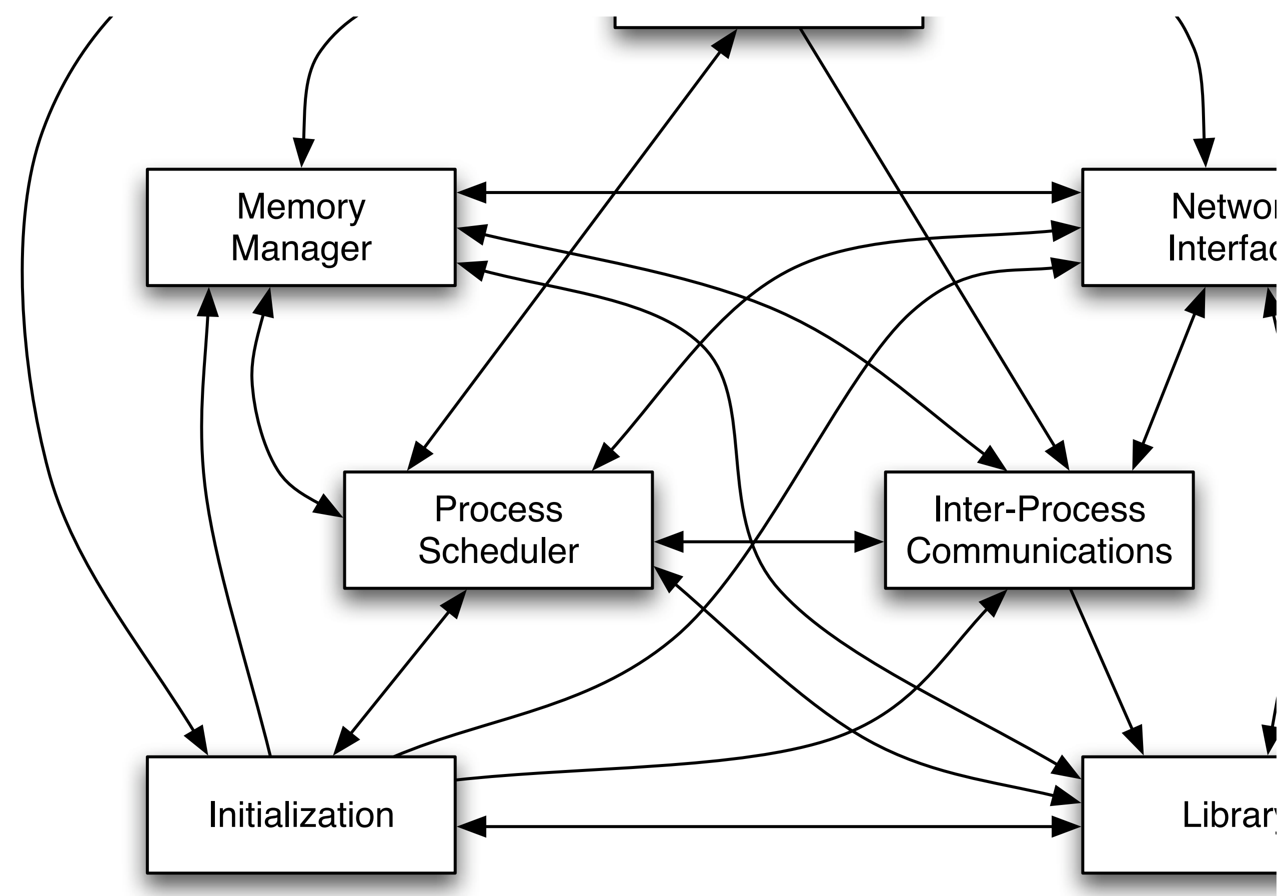
NFP: Complexity

- Complexity is a property that is proportional to the size of a system, its volume of constituent elements, their internal structure, and their interdependencies.

- Components:
  - Separate concerns.
  - Isolate functionality from interaction.
  - Ensure cohesiveness.
  - Insulate processing from data format changes.
- Connectors:
  - Isolate interaction from functionality.
  - Restrict interactions provided by each connector.
- Topology:
  - Eliminate unnecessary dependencies.
  - Use hierarchical (de)composition.

Connector complexity





NFP: Scalability / Heterogeneity

- Scalability: The capability of a system to be adapted to meet new size / scope requirements.
- Heterogeneity: A system's ability to be composed of, or execute within, disparate parts.
  - Internal: Ability to accommodate multiple kinds of components and connectors.
  - External: Ability to adjust to different platforms and environments (e.g., portability).
- Portability: The ability of a system to execute on multiple platforms while retaining their functional and non-functional properties.

NFP: Scalability / Heterogeneity

- Components:
  - Keep components focused (avoid bottlenecks).
  - Simplify interfaces (ease adding new components).
  - Avoid unnecessary heterogeneity (arch mismatch).
  - Distribute data sources (avoid bottlenecks).
  - Replicate data (caution: mutable vs immutable data).
- Connectors:
  - Use explicit connectors (natural scaling points).
  - Clearly define connector responsibilities (avoid bottlenecks).
  - Choose the simplest connectors (complexity dec. perf.).
  - Direct vs. indirect connectors (loose coupling, easy ext.).
- Topology:
  - Avoid bottlenecks.
  - Place data close to consumer (reduce network traffic).
  - Location transparency (move / expand services, data).

NFP: Evolvability

- Evolvability: The ability to change to satisfy new requirements and environments.

- Components:
  - Same as for complexity.
    - Goal is to reduce risks by isolating modifications.
- Connectors:
  - Clearly define responsibilities (make it easy track risk).
  - Make connectors flexible.
  - Enable connector composition (support new comps.).
- Topology:
  - Avoid implicit connectors (hard to understand).
  - Encourage location transparency (supports obliviousness).

NFP: Evolvability

NFP: Dependability

- Reliability: The probability a system will perform within its design limits without failure over time.
- Availability: The probability the system is available at a particular instant in time.
- Robustness: The ability of a system to respond adequately to unanticipated runtime conditions.
- Fault-tolerance: The ability of a system to respond gracefully to failures at runtime.
  - Faults arise from: environment, components, connectors, component-connector mismatches.
- Survivability: The ability to resist, recover, and adapt to threats.
  - Sources: attacks, failures, and accidents.
  - Steps: resist, recognize, recover, adapt.
- Safety: The ability to avoid failures that will cause loss of life, injury, or loss to property.

NFP: Dependability

- Components:
  - Control external component dependencies (insulation).
  - Support reflection (e.g., querying about health).
  - Support exception handling (adjust to failures).
  - Specify key state invariants (best, normal, worst-case).
- Connectors:
  - Use explicit connectors (insulate components).
  - Provide interaction guarantees (know how to react).
  - Use advanced connectors (replicas, mocks, etc.).
    - [Support seamless dependability]
- Topology:
  - Avoid single points of failure.
  - Enable back-ups (e.g., via advanced connectors).
  - Support system health monitoring (e.g., perf. analysis).
  - Support dynamic adaptation (e.g., dynamic discovery).

NFP: Security

- Security: "The protection afforded a system to preserve its integrity, availability, and confidentiality if its resources."
- Confidentiality
  - Preserving the **confidentiality** of information means preventing unauthorized parties from accessing the information or perhaps even being aware of the existence of the information. I.e., secrecy.
- Integrity
  - Maintaining the **integrity** of information means that only authorized parties can manipulate the information and do so only in authorized ways.
- Availability
  - Resources are **available** if they are accessible by authorized parties on all appropriate occasions.

Security arch. principles

- Least privilege:
  - Give each component only the privileges it requires.
- Fail-safe defaults
  - Deny access if explicit permission is absent.
- Economy of mechanism
  - Adopt simple security mechanisms.
- Open design
  - Secrecy != security.

Security arch. principles

- Separation of privilege
  - Introduce multiple parties to avoid exploitation of privileges.
- Least common mechanism
  - Limit critical resource sharing to only a few mechanisms.
- Psychological acceptability
  - Make security mechanisms usable.
- Defence in depth
  - Have multiple layers of countermeasures.

IIS Example

Access control

- Decide whether access should be granted.
  - Discretionary:
    - Based on the accessor’s identity, the resources, and whether the accessor has permissions.
  - Mandatory:
    - Policy based. (e.g., dominating labels)
  - Cross-cutting concern that should be investigated at an architectural level.

Discretionary access control

	DB	Component	Interface
Alice	Read-write; always	Bend	Y
Bob	Read-write; Between 9-5	Fold	N
Charles	No access	Spindle	N
Dave	No access	Mutilate	Y
Eve	Read-only; Always	Non	N

Mandatory access control

Trust management

- Trust is a subjective probability with which one agent assesses another agents will perform some specific action within a specific context.
- Reputation is the expectation of an agent's behaviour based on their past behaviours.
- Trust cannot be isolated to individual components.
  - Dominant concern in decentralized applications.
  - Architecture provides a foundation for reasoning about trust-related issues.