

CS 294: Unification vs. Specialization

November 30, 2015

Ion Stoica

(<http://www.cs.berkeley.edu/~istoica/classes/cs294/15/>)

Specialization vs Unification

Unification (one size fits all)

- » Spark (vs. specialized systems)
- » Windows
- » iOS (vs. game consoles)

Specialization (one size doesn't fit all)

- » Databases, Neo4j
- » Real-time systems
- » Game consoles

Specialization vs Unification

Specialization

- » High performance
- » Simpler API

Unification

- » Easier to use a 2nd app/workload
- » No learning curve

Specialization vs Unification

F 16



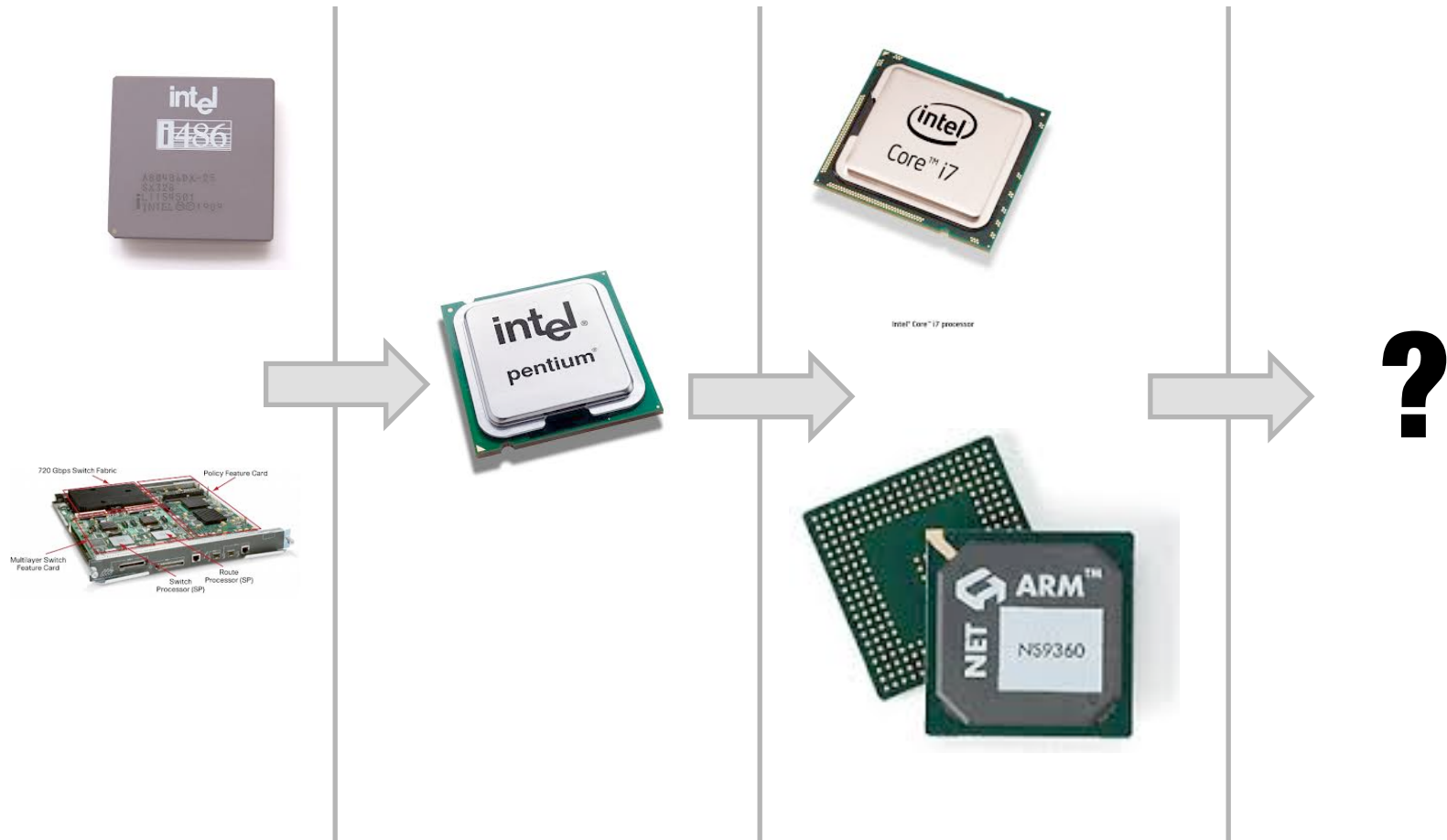
F 18



F 35



Specialization vs Unification



A Simple Model

$V(s)$: value of using system s

$O(s)$: overhead of using system s

- » Learn, manage, operate
- » Importing/exporting data
- » ...

$U(s)$: utility of using system s

$$U(s) = V(s) - O(s)$$

Specialization vs Unification

Assume we want to use a single system, s

Utility of specialized system:

$$U(s) = V(s) - O(s)$$

Utility of using s belonging to a unified framework F

$$U(s; F) = V(s; F) - O(s; F)$$

$$V(s) \geq V(s; F) \text{ and } O(s) \cong O(s; F) \rightarrow U(s) \geq U(s; F)$$

Specialization vs Unification

Assume we are using multiple systems, s_1, \dots, s_n

Utility of using n specialized system:

$$U(s_1, \dots, s_n) = \sum_{i=1}^n V(s_i) - \sum_{i=1}^n O(s_i)$$

Utility of using s_1, \dots, s_n provided by framework F

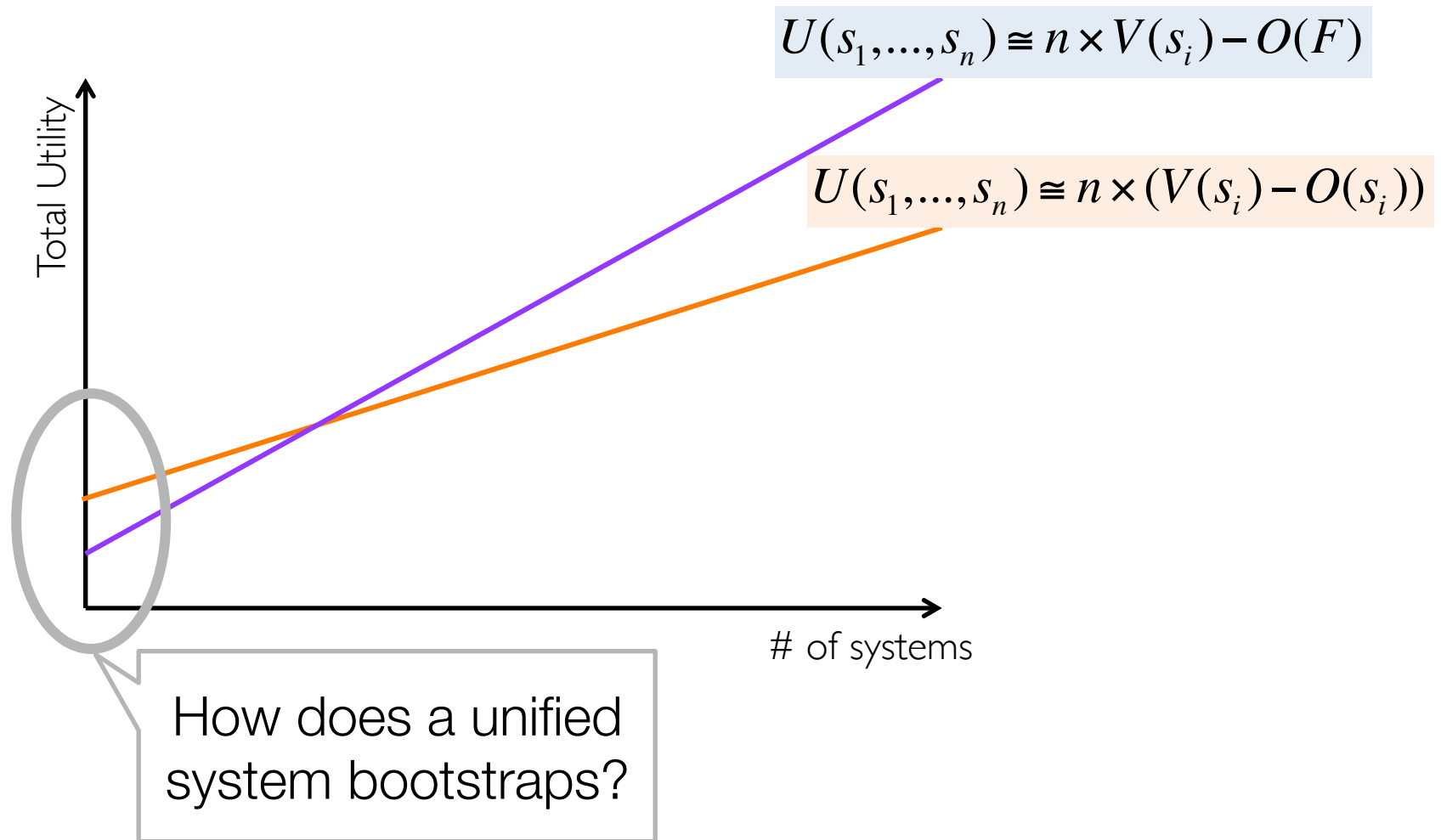
$$U(s_1, \dots, s_n; F) = \sum_{i=1}^n V(s_i; F) - O(s_1, \dots, s_n; F)$$

$O(s_1, \dots, s_n; F)$ is approx const, and $V(s_i) - O(s_i) < V(s_i; F) < V(s_i)$

$$U(s_1, \dots, s_n; F) \geq U(s_1, \dots, s_n)$$

for large enough n

Specialization vs. Unification



Unified System Bootstrapping?

1. Implement a system/app/functionality that is superior to what is out there
2. Rapidly build an ecosystem providing additional functionalities

Examples

Spark: better than MapReduce

» Not best for interactive queries, streaming

iOS: best phone OS

» Mediocre game platform

Windows: best for productivity apps

» Mediocre for multimedia (e.g., BeOS, NeXT much better)

Others

Network effect, i.e., value increases super-linearly

» Even bigger advantage to ecosystems!

...