



Wintersemester 2016/17

# Selected Topics in Efficient Algorithms

<http://www.albers.in.tum.de/index.html>

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# Organization

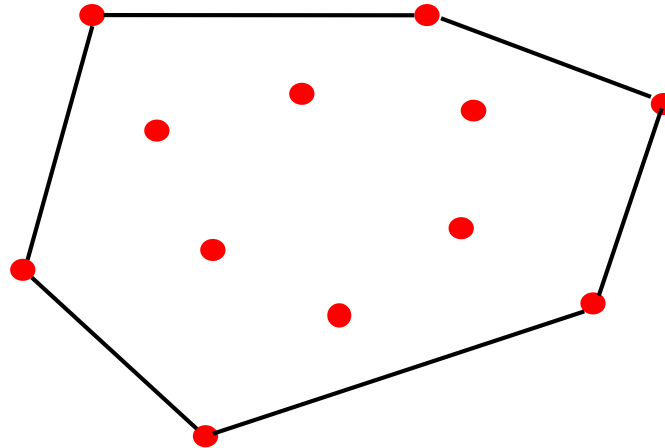
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Seminar Sessions: 2 SWS  
Mon 16:00–18:00, MI 03.11.018

Duties: Presentation of 60 minutes  
Write-up of 8 to 10 pages

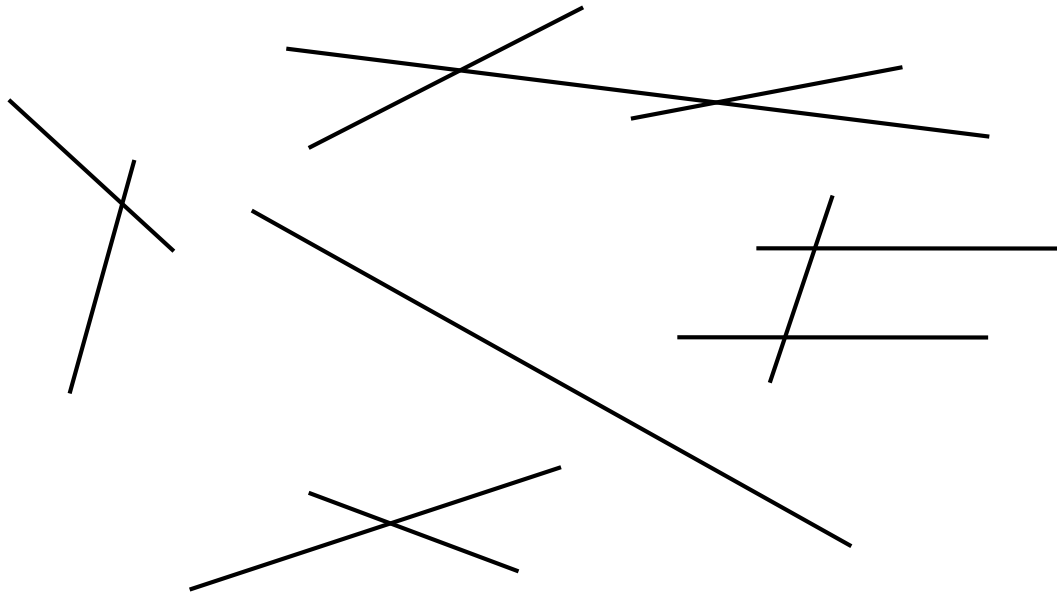
# 1. Computational geometry: Convex hulls



M. De Berg, O. Cheong, M. van Kreveld, M. Overmars.  
Computational Geometry. Chapter 1 & 11.

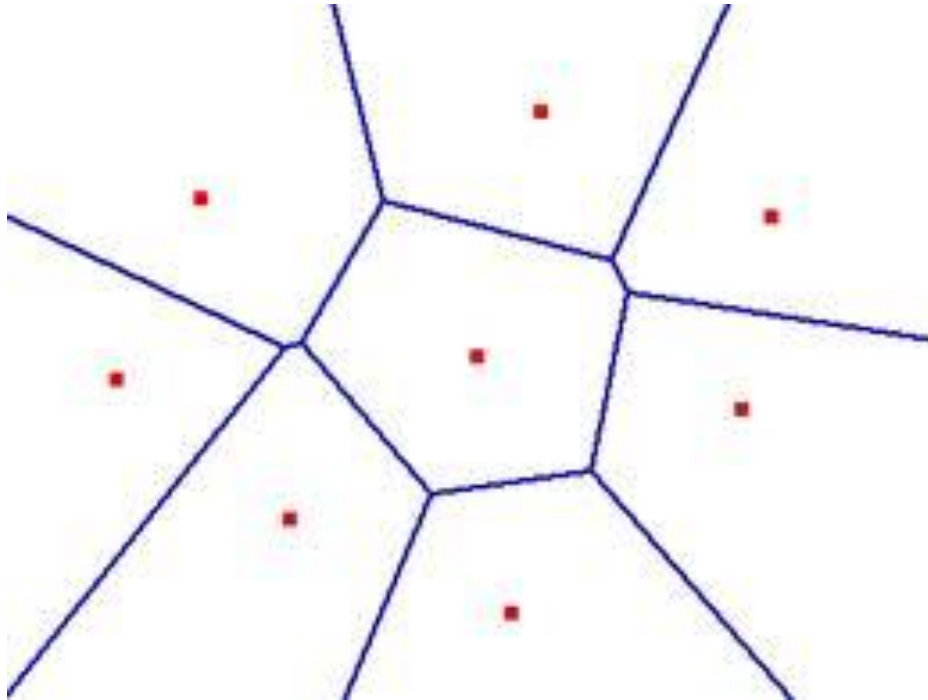
## 2. Comp. geometry: Line segment intersection

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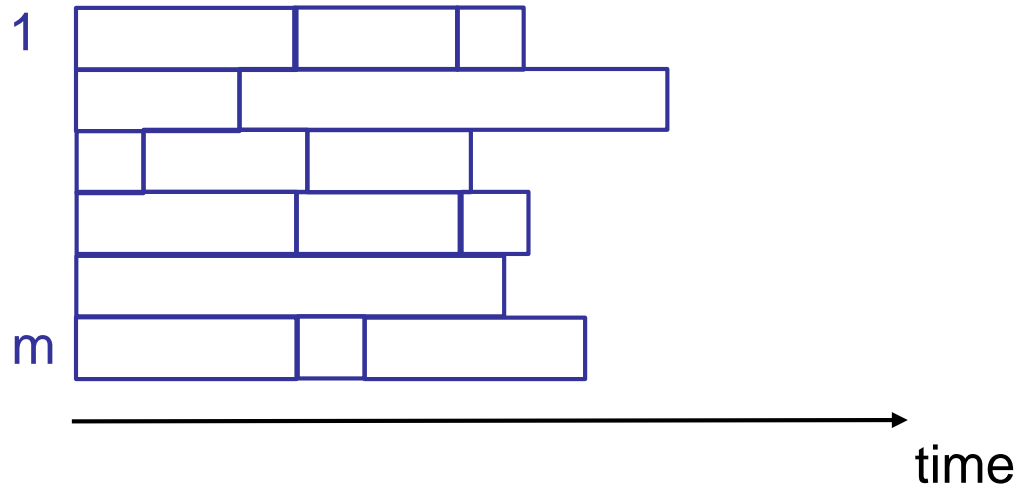
M. De Berg, O. Cheong, M. van Kreveld, M. Overmars.  
Computational Geometry. Chapter 2.

# 3. Comp. geometry: Voronoi diagrams



M. De Berg, O. Cheong, M. van Kreveld, M. Overmars.  
Computational Geometry. Chapter 7.

# 4. Scheduling: Makespan minimization



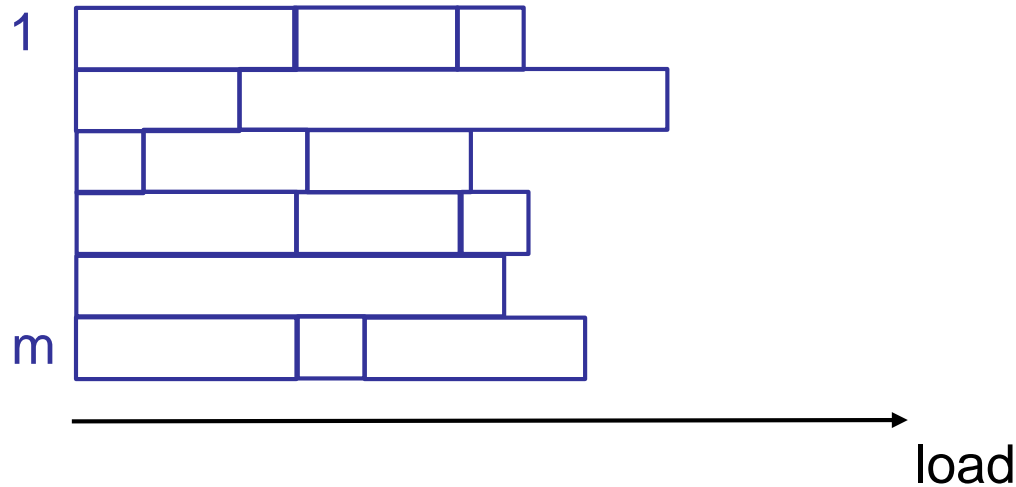
$m$  identical parallel machines

**Input portion:** Job  $J_i$  with individual processing time  $p_i$ .

**Goal:** Minimize the completion time of the last job in the schedule.

R. Graham. Bell Systems Techn. Journal 1965;  
SIAM J. Applied Math., 1969.

# 5. Scheduling: Load balancing game



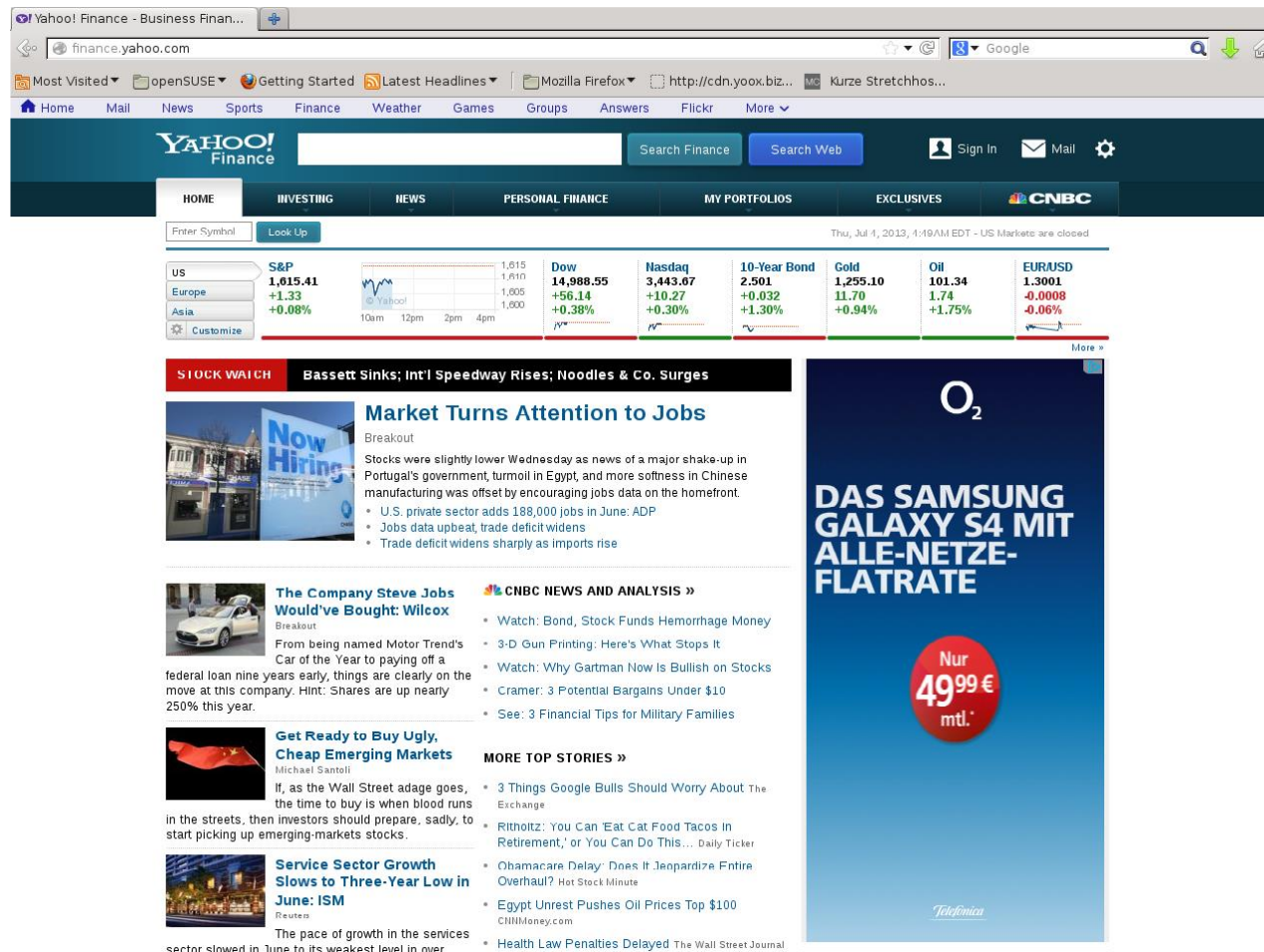
Each job controlled by **selfish agent**.

**Cost of an agent** is the load of the selected machine.

**Social cost:** Makespan of the solution.

B. Vöcking. In: Algorithmic Game Theory, Chapter 20, 2007.

# 6.Scheduling: Story boarding

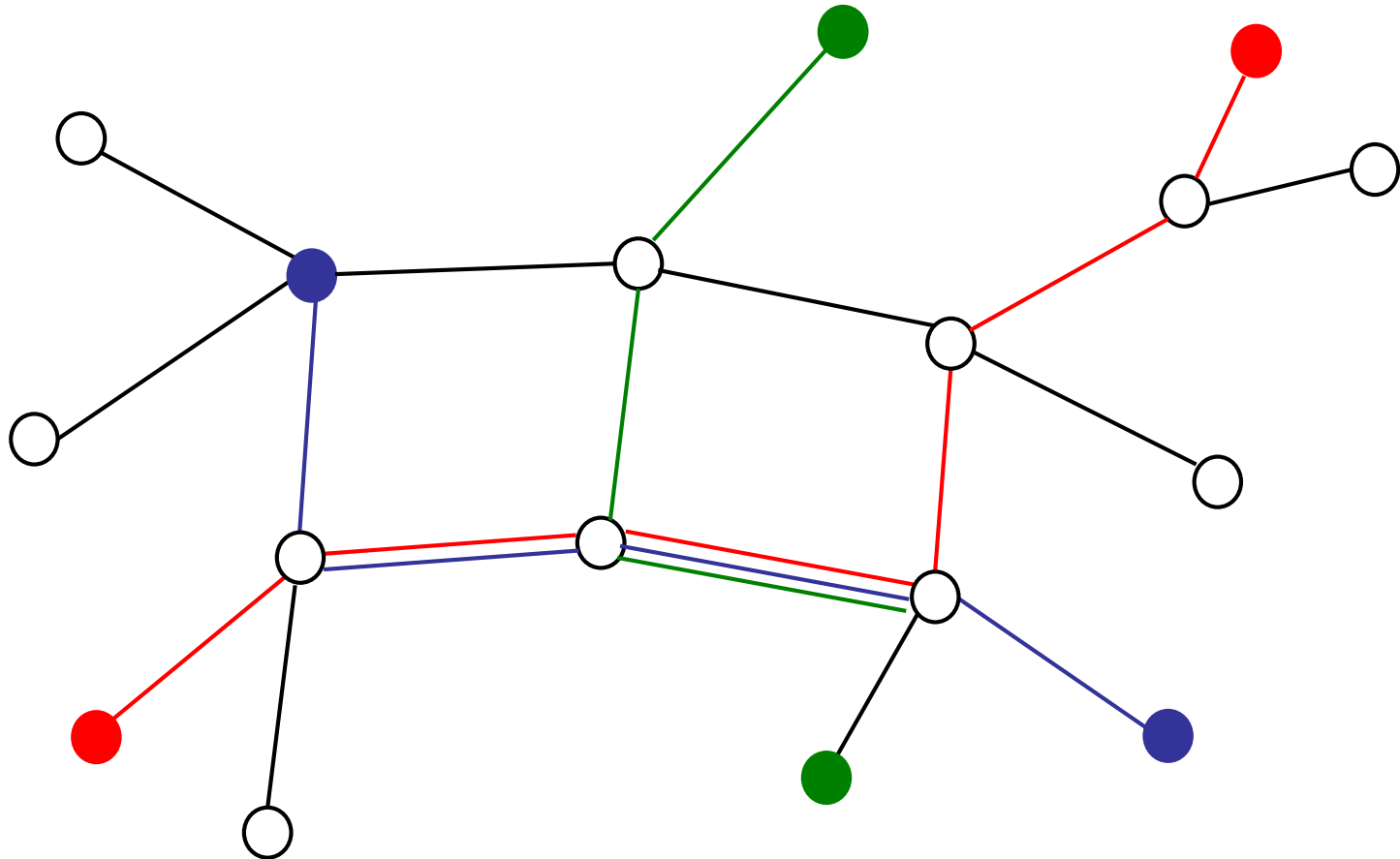


The screenshot shows the Yahoo! Finance website interface. At the top, there's a navigation bar with 'HOME', 'INVESTING', 'NEWS', 'PERSONAL FINANCE', 'MY PORTFOLIOS', 'EXCLUSIVES', and 'CNBC'. Below this is a search bar and a 'Sign In' button. The main content area features a 'STOCK WATCH' section with a headline 'Bassett Sinks; Int'l Speedway Rises; Noodles & Co. Surges'. A prominent article titled 'Market Turns Attention to Jobs' is displayed, with a sub-headline 'Breakout' and a brief summary: 'Stocks were slightly lower Wednesday as news of a major shake-up in Portugal's government, turmoil in Egypt, and more softness in Chinese manufacturing was offset by encouraging jobs data on the homefront.' Below this are several bullet points: 'U.S. private sector adds 188,000 jobs in June: ADP', 'Jobs data upbeat, trade deficit widens', and 'Trade deficit widens sharply as imports rise'. To the right of the main article is a large advertisement for the Samsung Galaxy S4, featuring the text 'DAS SAMSUNG GALAXY S4 MIT ALLE-NETZE-FLATRATE' and a price tag of 'Nur 4999 € mtl.'. Other news snippets include 'The Company Steve Jobs Would've Bought: Wilcox' and 'Get Ready to Buy Ugly, Cheap Emerging Markets'. A 'CNBC NEWS AND ANALYSIS' section lists several watch items like 'Bond, Stock Funds Hemorrhage Money' and '3-D Gun Printing: Here's What Stops It'. A 'MORE TOP STORIES' section includes '3 Things Google Bulls Should Worry About The Exchange', 'Ritnoitz: You Can 'Eat Cat Food Tacos in Retirement,' or You Can Do This...', 'Obamacare Delay: Does It Jeopardize Entire Overhaul? Hot Stock Minute', 'Egypt Unrest Pushes Oil Prices Top \$100', and 'Health Law Penalties Delayed'.

A. Dasgupta, A. Ghosh, H. Nazerzadeh, P. Raghavan SODA 2009.  
 S. Albers, A. Passen, ICALP 2013.



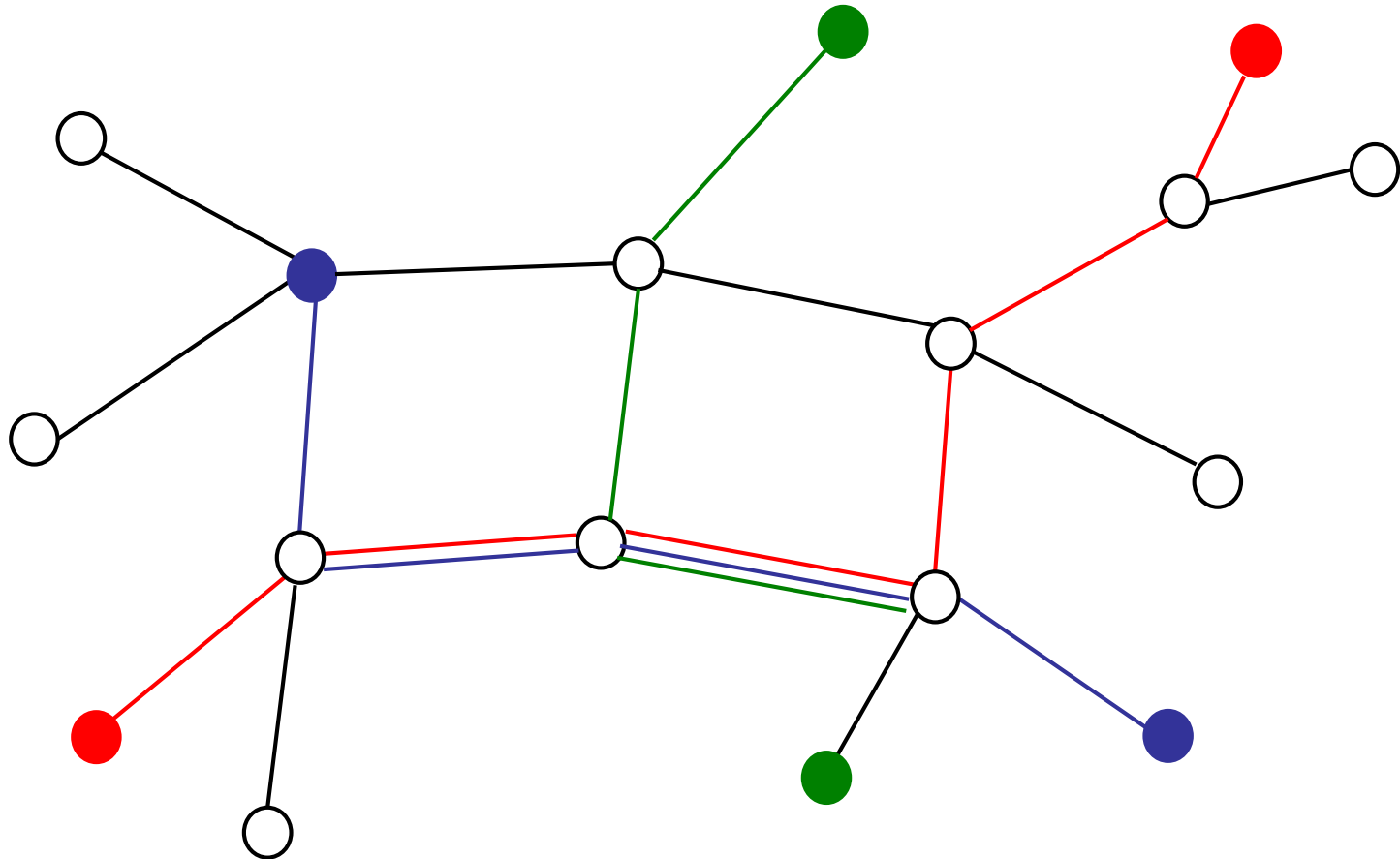
# 7. Network design: Fair cost allocation



$G=(V,E,c)$  pairs  $(s_i,t_i)$  If  $k$  agents use  $e$ , each pays  $c(e)/k$

Anshlevich, Dasgupta, Kleinberg, Tardos, Wexler. SICOMP 2008.

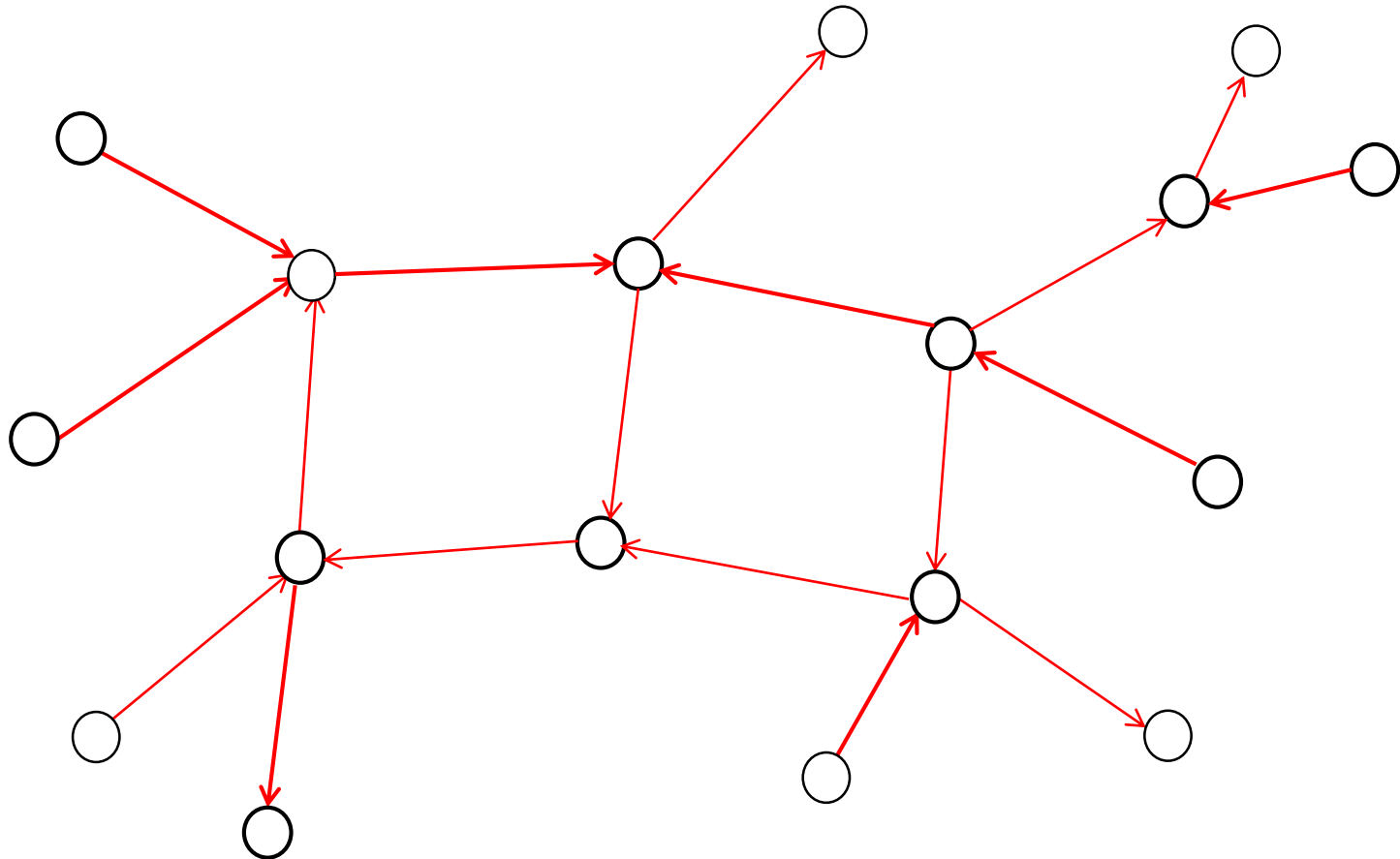
# 8. Network design: Arbitrary payments



$G=(V,E,c)$  pairs  $(s_i,t_i)$  Cost of an edge may be split arbitrarily.

Anshlevich, Dasgupta, Tardos, Wexler. Theory of Computing, 2008.

## 9. Network creation

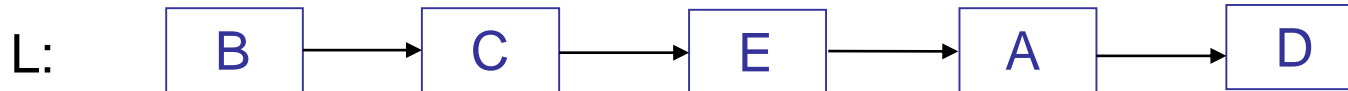


Cost agent  $i = a \cdot \# \text{ edges built} + \sum_{i \neq j} \text{distance to agent } j$

Fabrikant, Luthra, Maneva, Papadimitriou, Shenker.  
On a network creation game. PODC 2003.

# 10. Data structures: List update

Unsorted linear list



$\sigma = A A C B E D A \dots$

**Request:** Access to item in the list

**Cost:** Accessing the  $i$ -th item in the list incurs a cost of  $i$ .

**Goal:** Minimize cost paid in serving  $\sigma$ .

**Applications:** Data compression

S. Albers, S. Lauer. On list update with locality of reference. ICALP 2008.

# 11. Paging with locality of reference

Two-level memory system



small fast memory



large slow memory

$\sigma = A C B E D A F \dots$

**Request:** Access to page in memory system

**Goal:** Minimize the number of page faults

Panagiotou, Souza: On adequate performance measures for paging.  
STOC 2006.

# 12. Paging with locality of reference

Two-level memory system



small fast memory



large slow memory

$\sigma = A C B E D A F \dots$

**Request:** Access to page in memory system

**Goal:** Minimize the number of page faults

Albers, Frascaria: Quantifying competitiveness in paging with locality of reference. ICALP 2015.