

# Collaborative Computing

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Thanks to Nicolas Roussel, Inria



# Humans are social beings ...

Groups structure human activity

Professional life: teams, management chain,

Private life: family, friends, sport teams, choir, etc.

Groups are more than the sum of their parts

- Division of labor

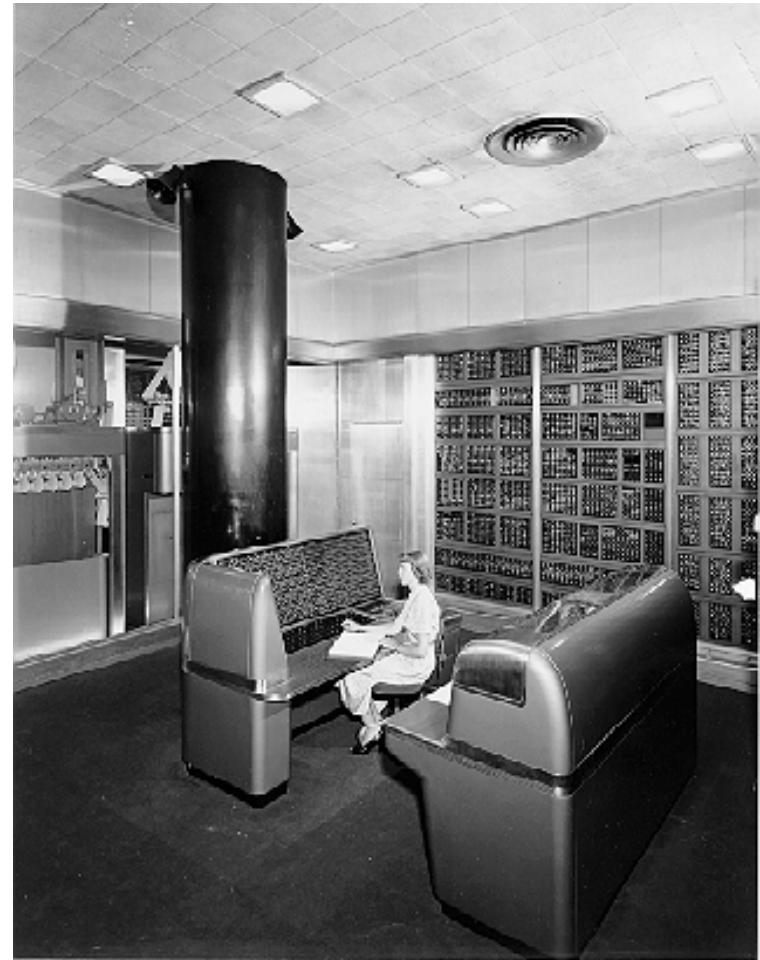
- Take advantage of different expertise

- Transfer of skills: learning

## ... but computers are (mostly) personal

Time-sharing systems create the illusion that each user has access to all the resources and do not support awareness of what other users are doing.

Example: file system



IBM SSEC, 1948

# We still live in the era of the Personal Computer

One user

One computer

One task at a time





# Don Norman

*"Most work done on any complex entity  
is done by more than one person"*



*"Social impact of technology is hard to predict"*

# *Augmenting the human intellect*

1968 : Engelbart and his colleagues create NLS/Augment, a system that supported file sharing, personal annotations, electronic messaging, videoconferencing, screen sharing, telepointers, etc.

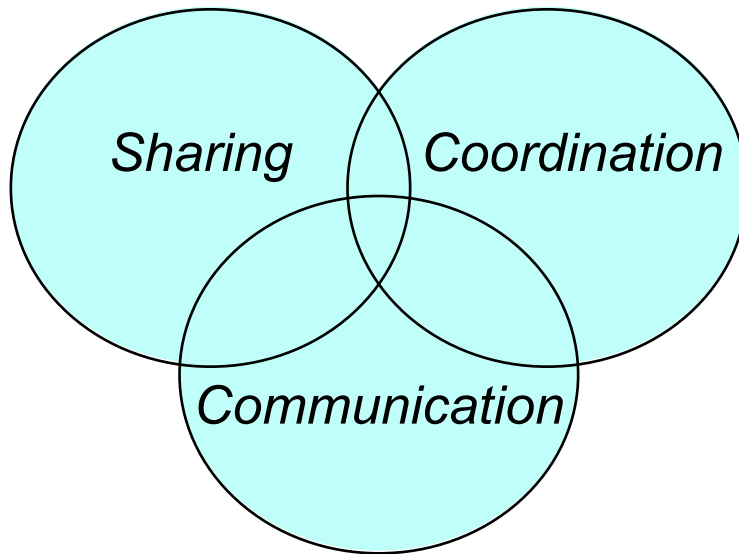


# Collaborative computing

Computer-based systems  
that support  
**groups of people**  
engaged in  
a **common task** (or goal)  
and that provide  
an interface to a **shared environment**

*Ellis, Gibbs & Rein, 1991*

# Functional taxonomy



## **Communication**

exchanging information  
among participants

## **Sharing**

creating and editing  
digital artifacts

## **Coordination**

division of labor  
among participants

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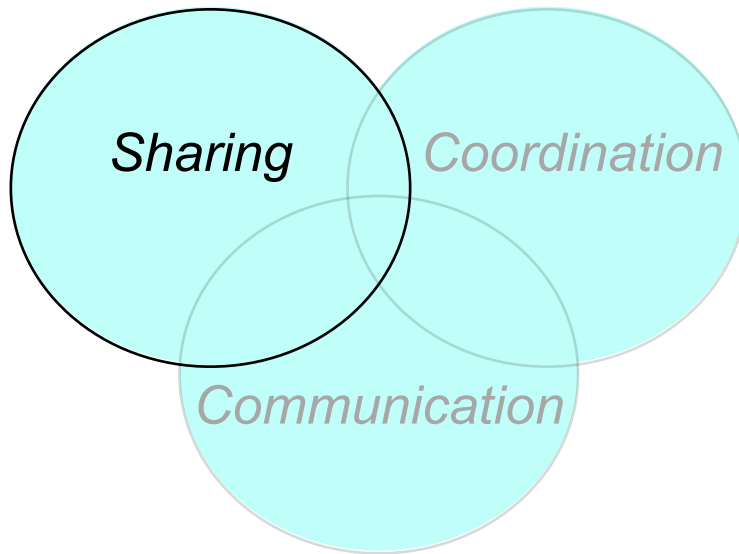
# A sample of collaborative computing systems

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# Some groupware systems

- e-mail, distribution lists
- discussion groups
- chat, talk, IRC
- workflow systems
- group calendars
- shared editors
- audio-video communication systems
- argumentation tools
- roomware, collaborative buildings
- social networks
- etc.

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# Colab

Stefik et al., 1987

Meetings of small group in a specially-equipped room

“Shared external memory”

Boardnoter : hand drawing

Cognoter : outlining ideas

Argnoter : argumentation spreadsheet



View, space and time **congruence**

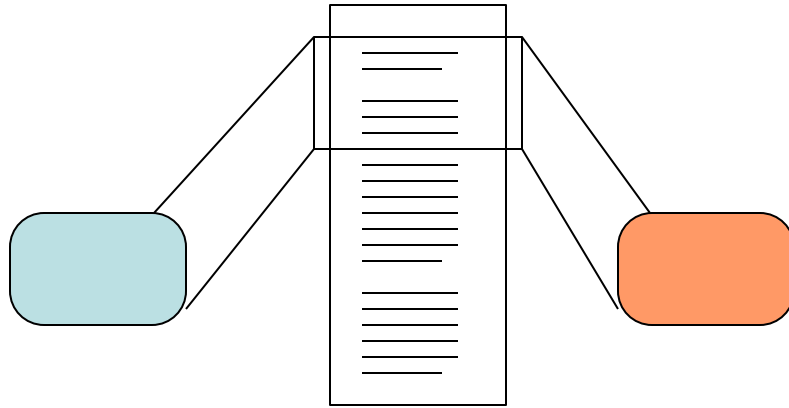
What You See is What I See

What You See Is Almost What I See

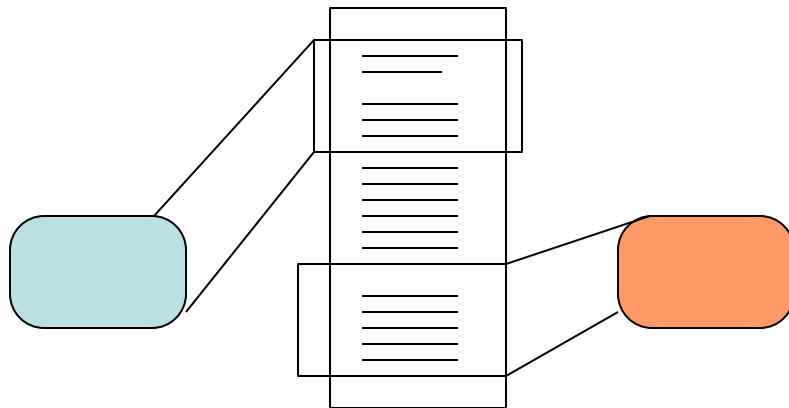
Shared **awareness**

Perceive what the others are doing  
e.g., telepointers

# WYSIWIS / WYSIAWIS



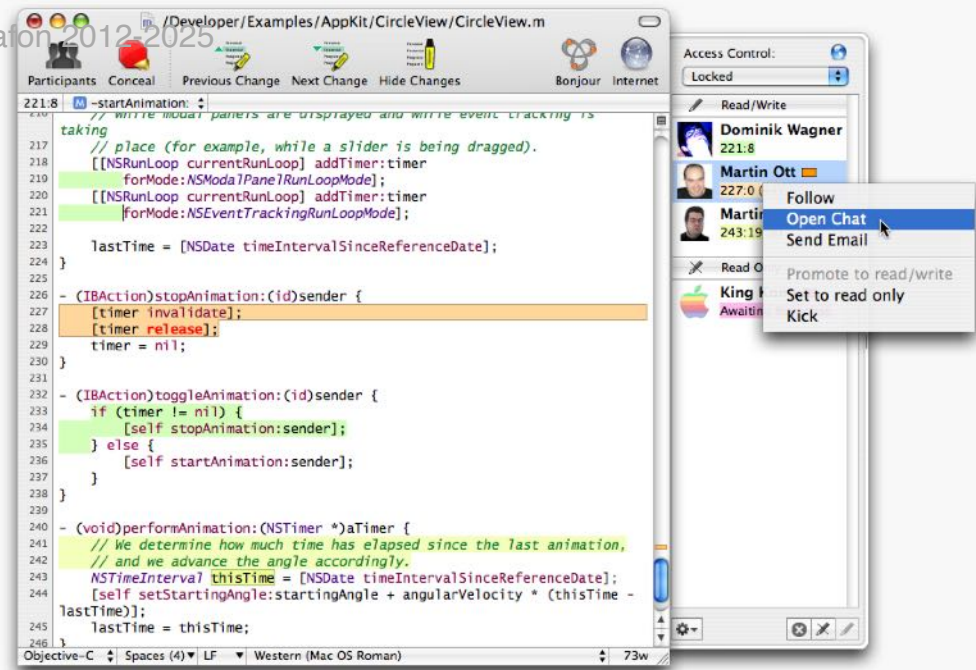
WYSIWIS  
Strict view congruence



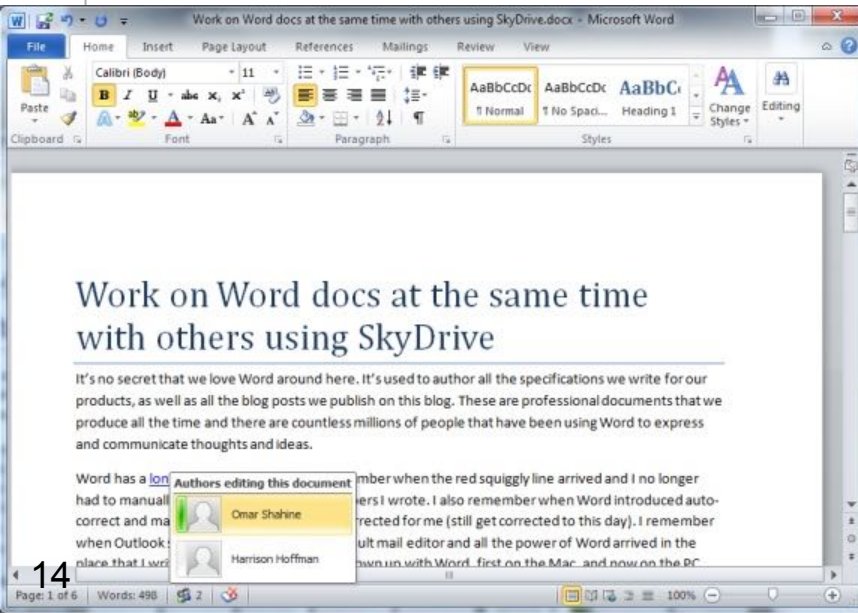
WYSIAWIS  
Relaxed congruence

# Modern systems

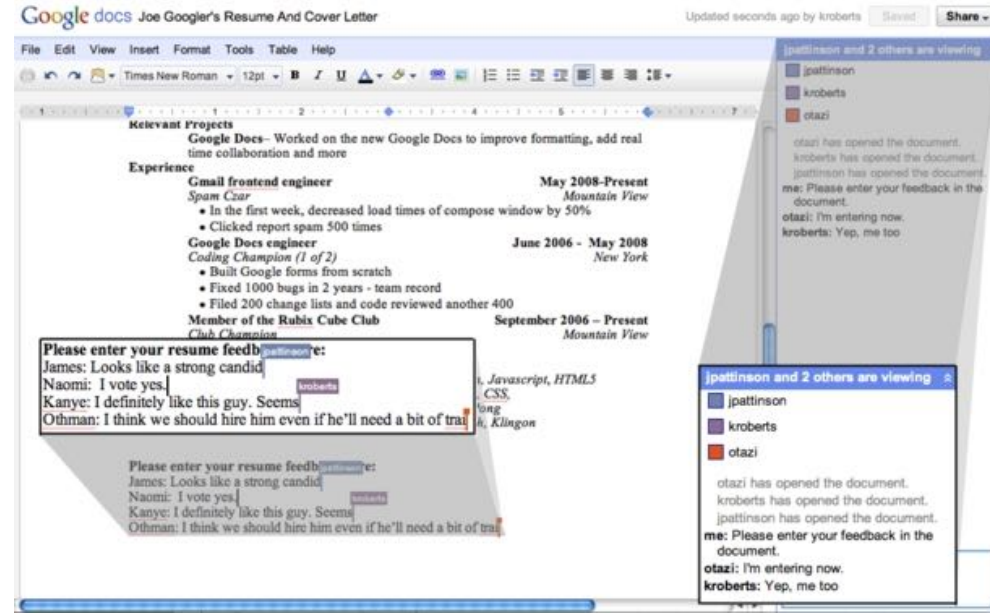
SubethaEdit



Microsoft Office

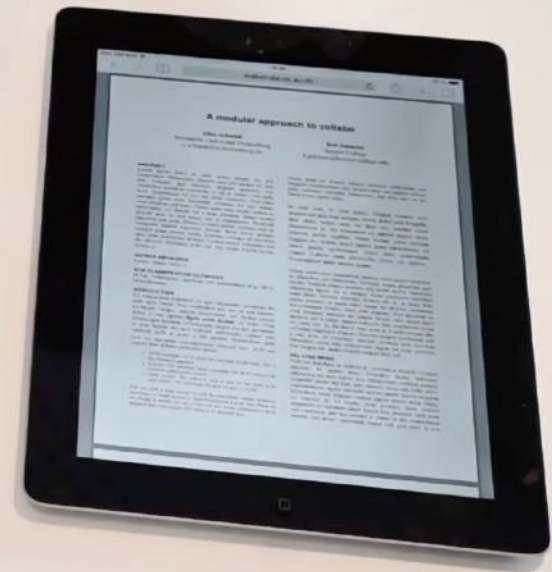
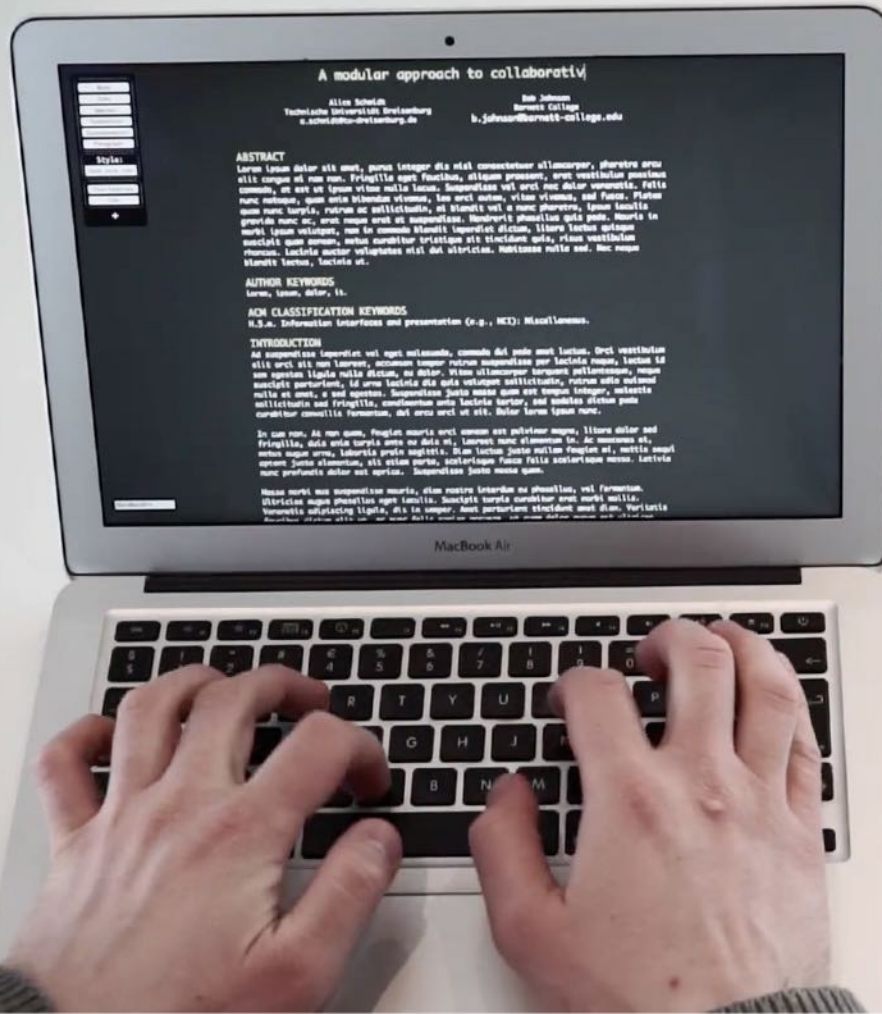


Google docs



# Webstrates

Klokmoose, Eagan, Baader,  
Mackay, Beaudouin-Lafon, 2015



# Collaborative software development

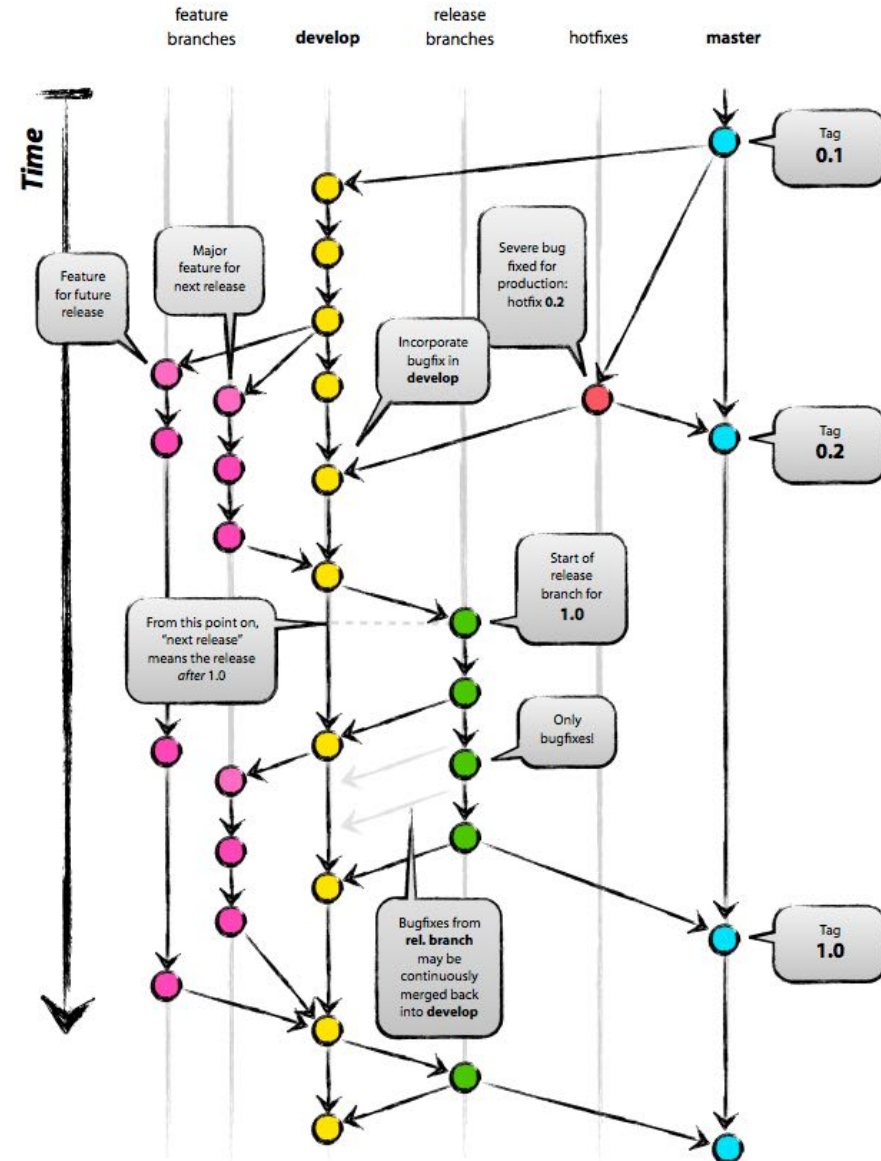
Version control

git

Asynchronous

Centralized

Conflict management



# Usability

git conceptual model is complex and can be counter-intuitive

See the article by Perez de Rosso & Jackson, "What's wrong with git?: a conceptual design"

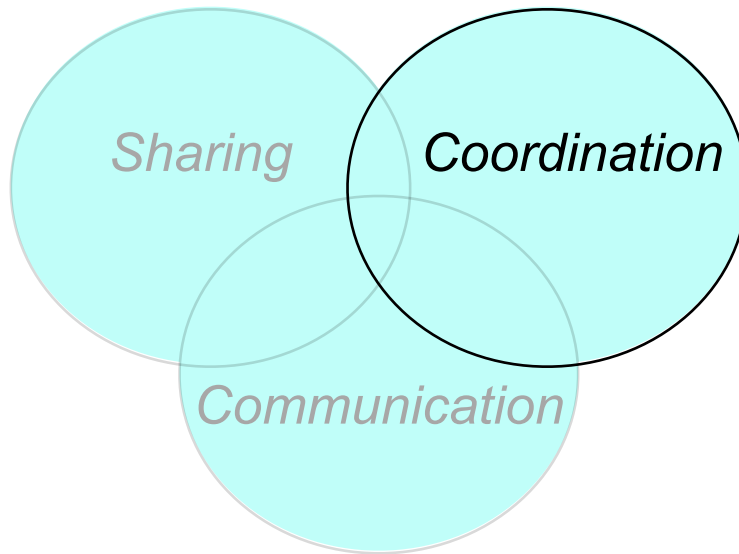
THIS IS GIT. IT TRACKS COLLABORATIVE WORK ON PROJECTS THROUGH A BEAUTIFUL DISTRIBUTED GRAPH THEORY TREE MODEL.

COOL. HOW DO WE USE IT?

NO IDEA. JUST MEMORIZE THESE SHELL COMMANDS AND TYPE THEM TO SYNC UP. IF YOU GET ERRORS, SAVE YOUR WORK ELSEWHERE, DELETE THE PROJECT, AND DOWNLOAD A FRESH COPY.



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# Workflow systems

Managing a document across an organization

Example : a document includes metadata describing its path through an organization

- must be written by Anne by April 15
- must be proofread by Bob bt April 22
- must be approved by Charlie by April 29
- must be sent to Charlie by May 4

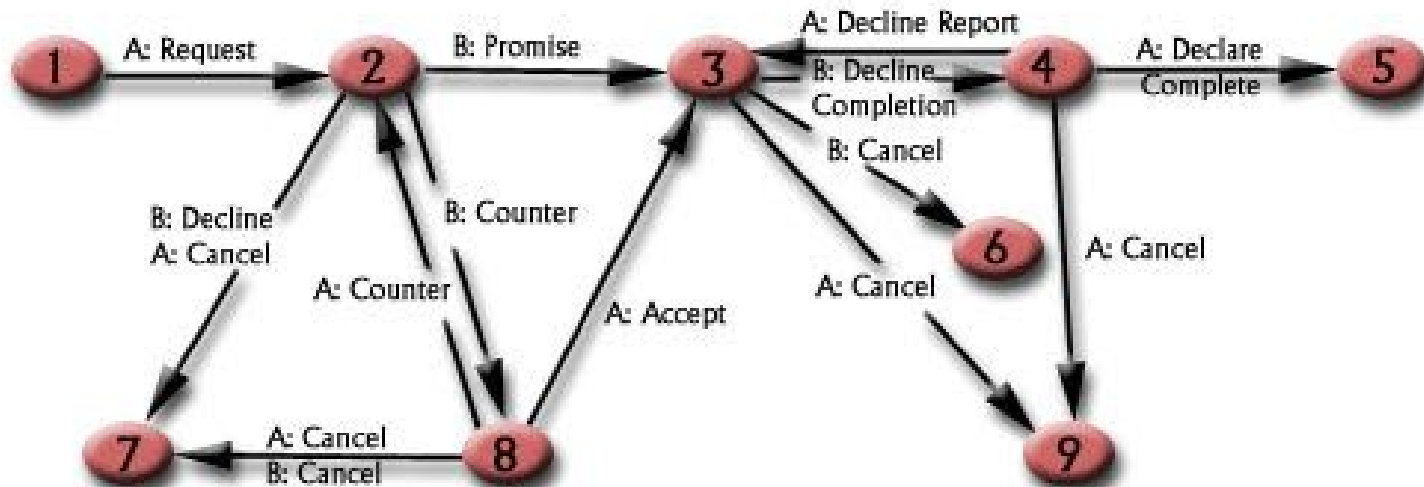
The document "knows its way"  
and can send reminders  
to the various people involved



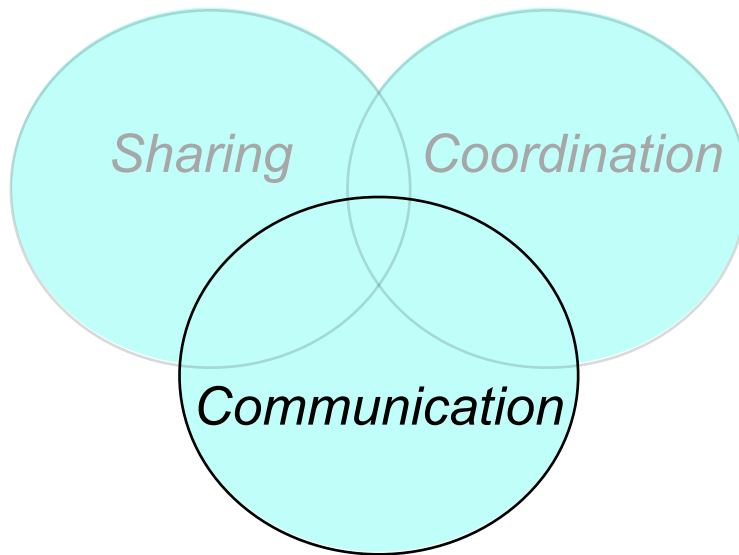
# The Coordinator

Winograd &amp; Flores, 1988

Based on the theory of speech acts



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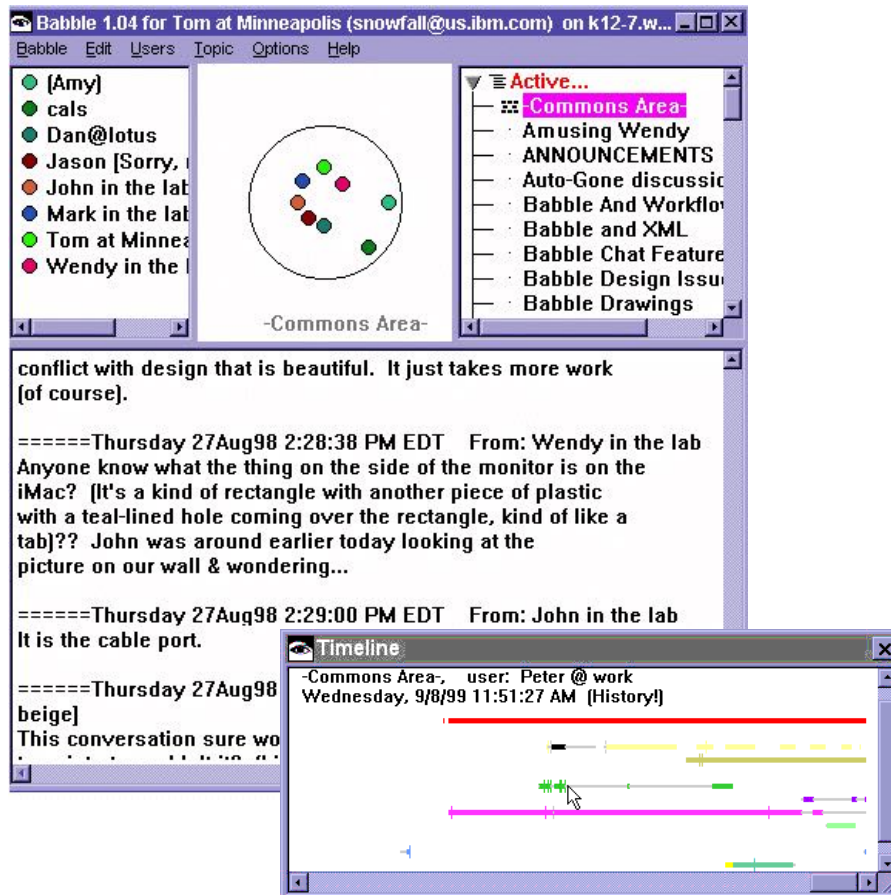
# From communication to social networking

```
[No connection yet]
[Connection established with hipo@localhost.]
hi glad to talk ya t00
how iz life ??
```

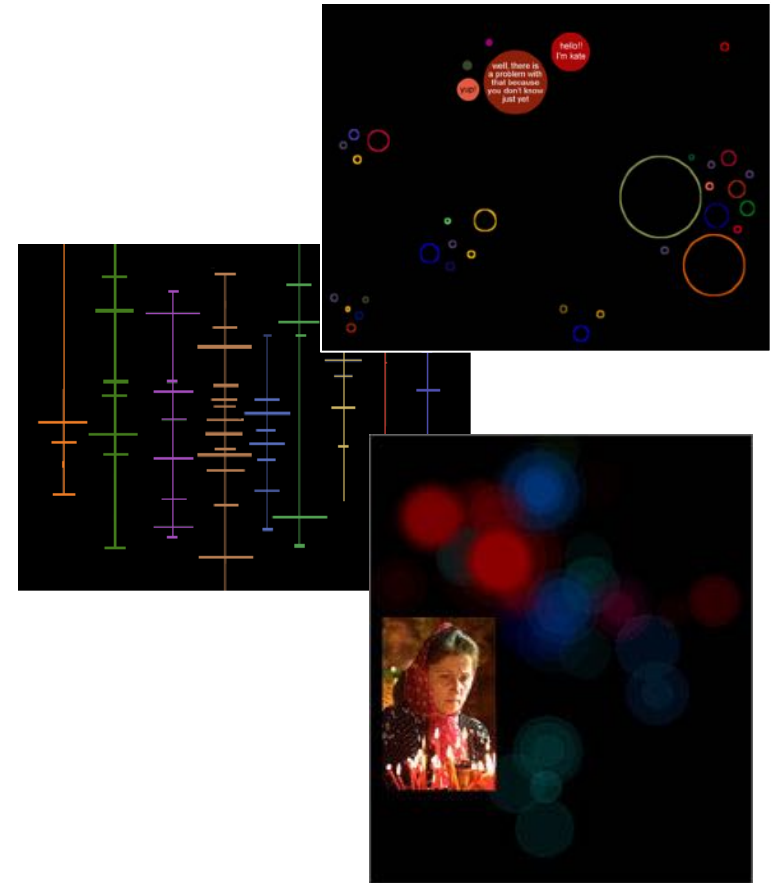
```
hi hi ;)
Glad to talk you here.
```

Unix talk

# Chat rooms



Babble (Bradner et al., 1988)  
<http://www.research.ibm.com/SocialComputing/babble.htm>



Chat circles (Viégas et al., 1999)  
<http://web.media.mit.edu/~fviegas/circles/>  
<http://web.media.mit.edu/~fviegas/CC2/>

# Social networks

From connecting people ... to controlling them  
The economy of attention



# Interoperability vs lock-in



# Video-conferencing

Great hopes



Copyright 2007 www.DVEtelepresence.com

DVE



Polycom

Great disappointment

Expensive

Technical problems: sound, eye contact

# Video-mediated communication: mediaspaces

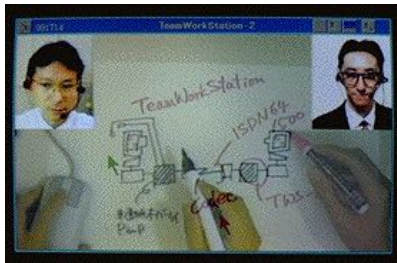
Hole-in-Space (1980)



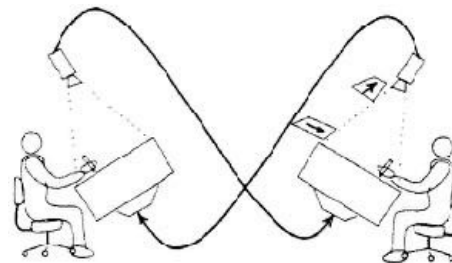
Mediaspaces (1983-)



TeamWorkStation (1990)



VideoDraw (1991)



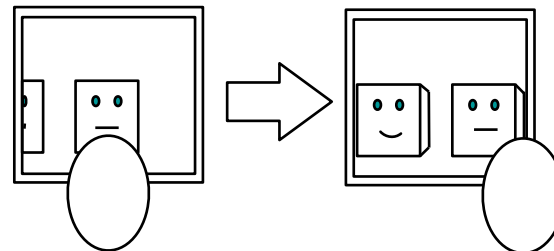
ClearBoard (1991-94)



Videoplace (1974-85)



Virtual window (1995)



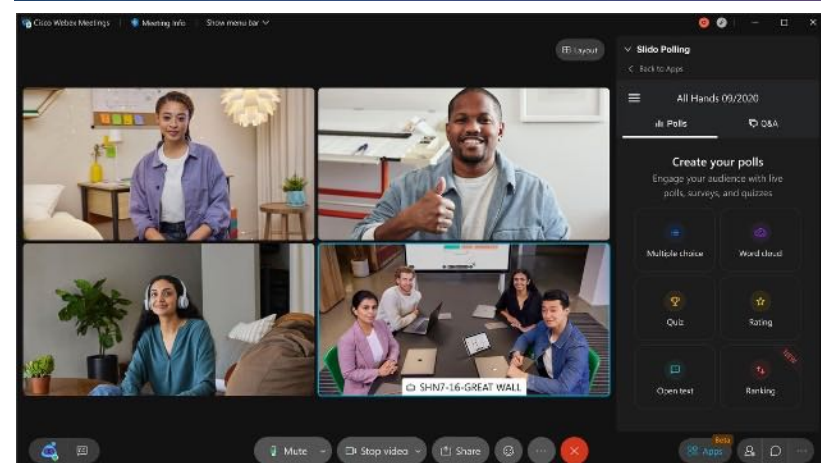
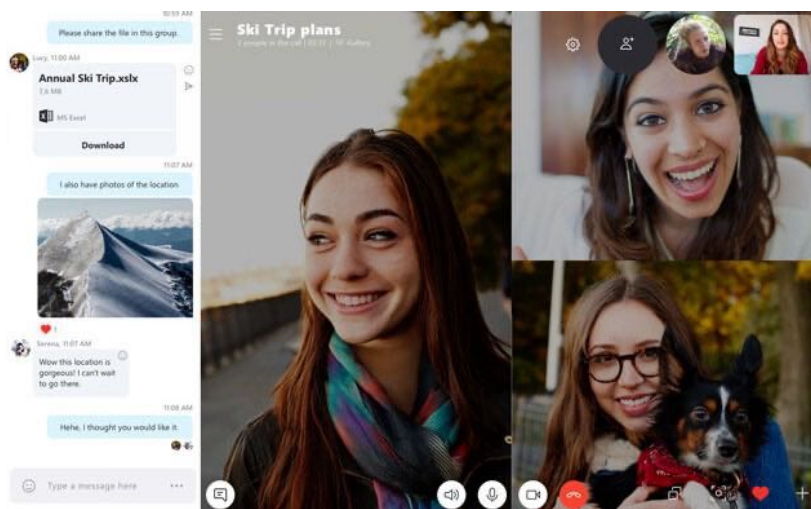
# Clearboard

Ishii et al., 1992



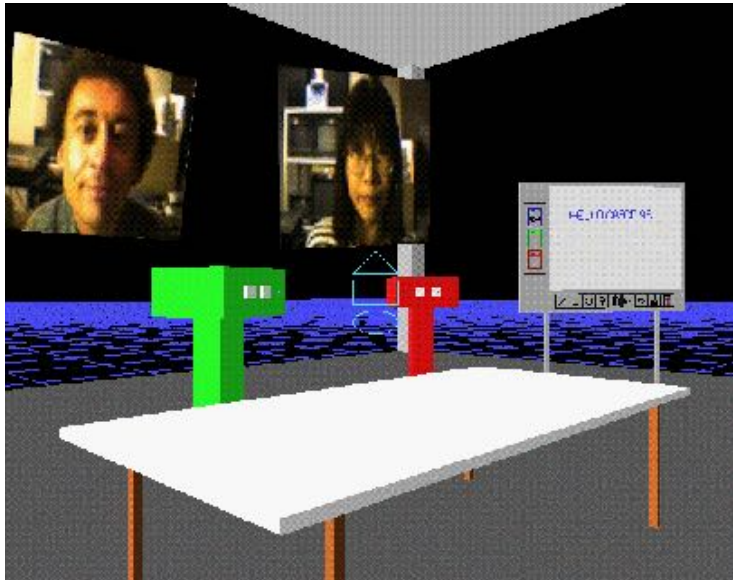
# The failure of mediaspaces

Zoom, Teams, Webex, Google Meet, etc, are **all the same**



# Collaborative Virtual Environments

Represent participants by avatars in a virtual world



DIVE (1991)



Second Life (2005)

# Collaborative Virtual Environments

Networked games



Civilization

The metaverse



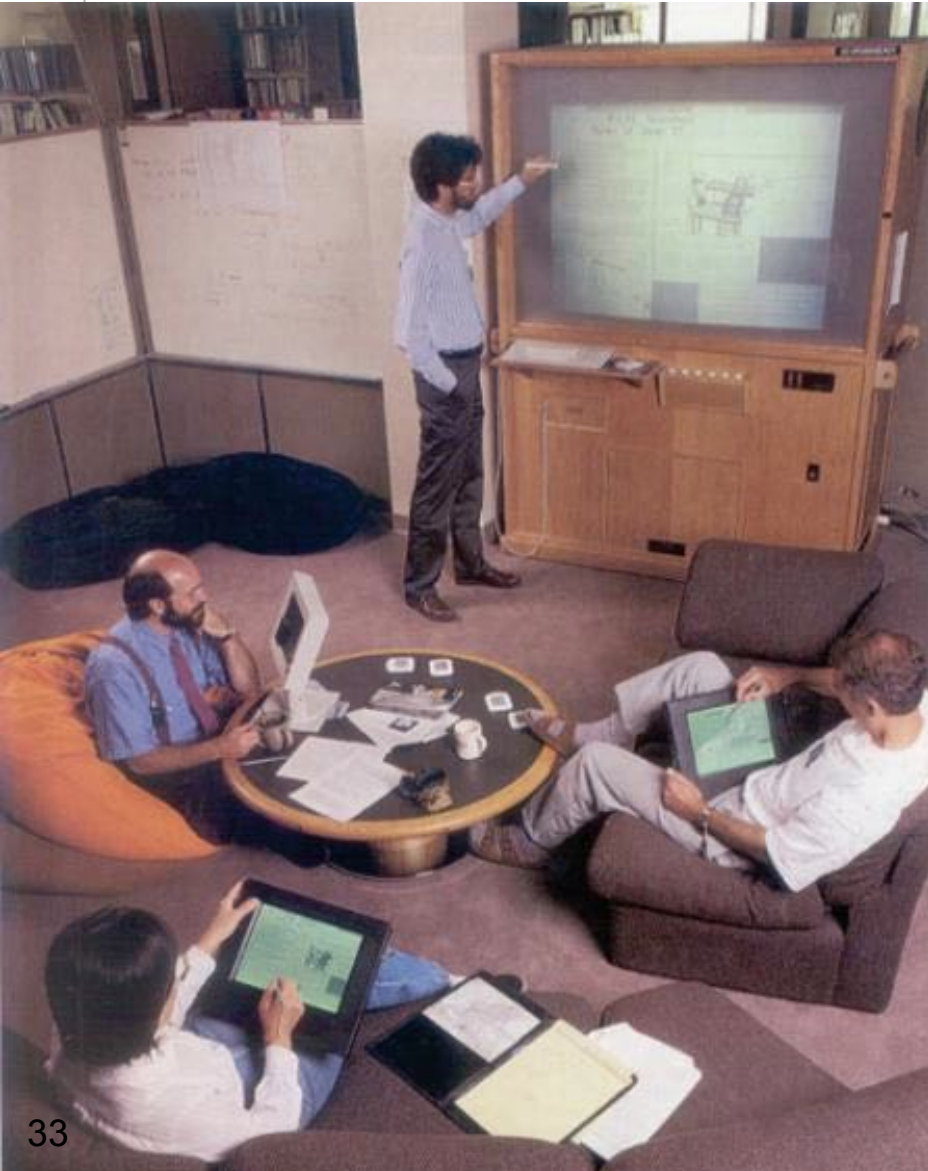
Horizon Worlds

# Beyond “being there”

Spacetime [Xia et al., 2018]



# Ubiquitous computing



Cooperative buildings  
(Streitz et al., 1998)

Ubicomp (Weiser, 1991)

# Interaction in the large



# CamRay

Avellino, Fleury, Mackay, Beaudouin-Lafon, 2017



**What about remote collaboration  
across wall-sized displays?**

# CamRay: follow-remote



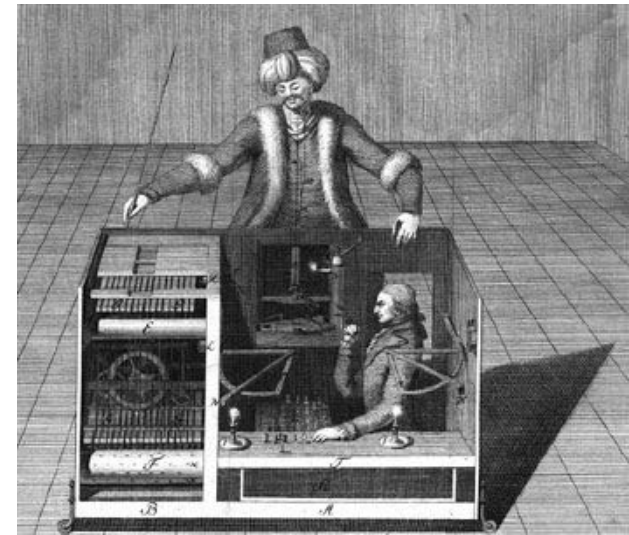
# CamRay: follow-local



# Crowdsourcing

Harness the power of the crowd

Combine human intelligence  
with machine computation



# Soylent: a computer with a crowd inside

Bernstein, 2010

Soylent is available open-source under the MIT license, and is hosted on [Google Code](#). Contact us at [soylent@csail.mit.edu](mailto:soylent@csail.mit.edu).

Press for the project:

WIRED

Technology  
Review

Harvard's Nieman  
Journalism Lab

The screenshot shows a video player displaying a presentation slide. The slide is titled "Shortn" and contains two columns of text. The top column text is partially obscured by a large, semi-transparent pink arrow pointing to the right. The bottom column text is also partially obscured by a large, semi-transparent pink arrow pointing to the right. The video player interface at the bottom shows a progress bar at 0:54 / 2:36 and a volume icon.

**Shortn**

Automatic clustering generally helps separate different kinds of records that need to be edited differently, but it isn't perfect. Sometimes it creates more clusters than needed, because the differences in structure aren't important to the user's particular editing task. For example, if the user only needs to edit near the end of each line, then differences at the start of the line are largely irrelevant, and it isn't necessary to split based on those differences. Conversely, sometimes the clustering isn't fine enough, leaving heterogeneous clusters that must be edited one line at a time. One solution to this problem would be to let the user rearrange the clustering manually, perhaps using drag-and-drop to merge and split clusters. Clustering and selection generalization would also be improved by recognizing common text structure like URLs, filenames, email addresses, dates, times, etc.

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# Taxonomies

Several ways to classify systems:

- Time, space and size of the group
- Sharing (e.g., editors) vs. exchanging (e.g., email)
- Structured (e.g., workflow systems),  
vs. open (e.g., whiteboards)
- Strong vs. weak computer support

# Time-space matrix

Johansen, 1988

	Same place	Different place
Same time	face-to-face conversation	telephone call
Different time	Post-it note	letter

# Challenges for groupware developers



Jonathan Grudin

- Who does the work vs. who gets the benefit
- Critical mass and Prisoner's dilemma problems
- Disruption of social processes
- Exception handling
- Unobtrusive accessibility
- Difficulty of evaluation
- Failure of intuition
- Careful adoption process

# Privacy, and other social behaviors



*"On the Internet, nobody knows you're a dog."*

Plausible deniability

