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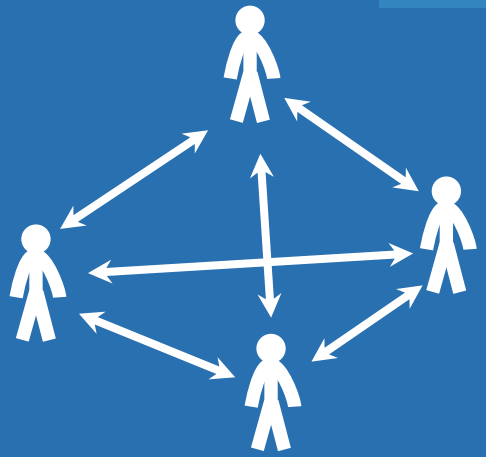
Sharing strategies:
Optimal networks for team collaboration and problem solving



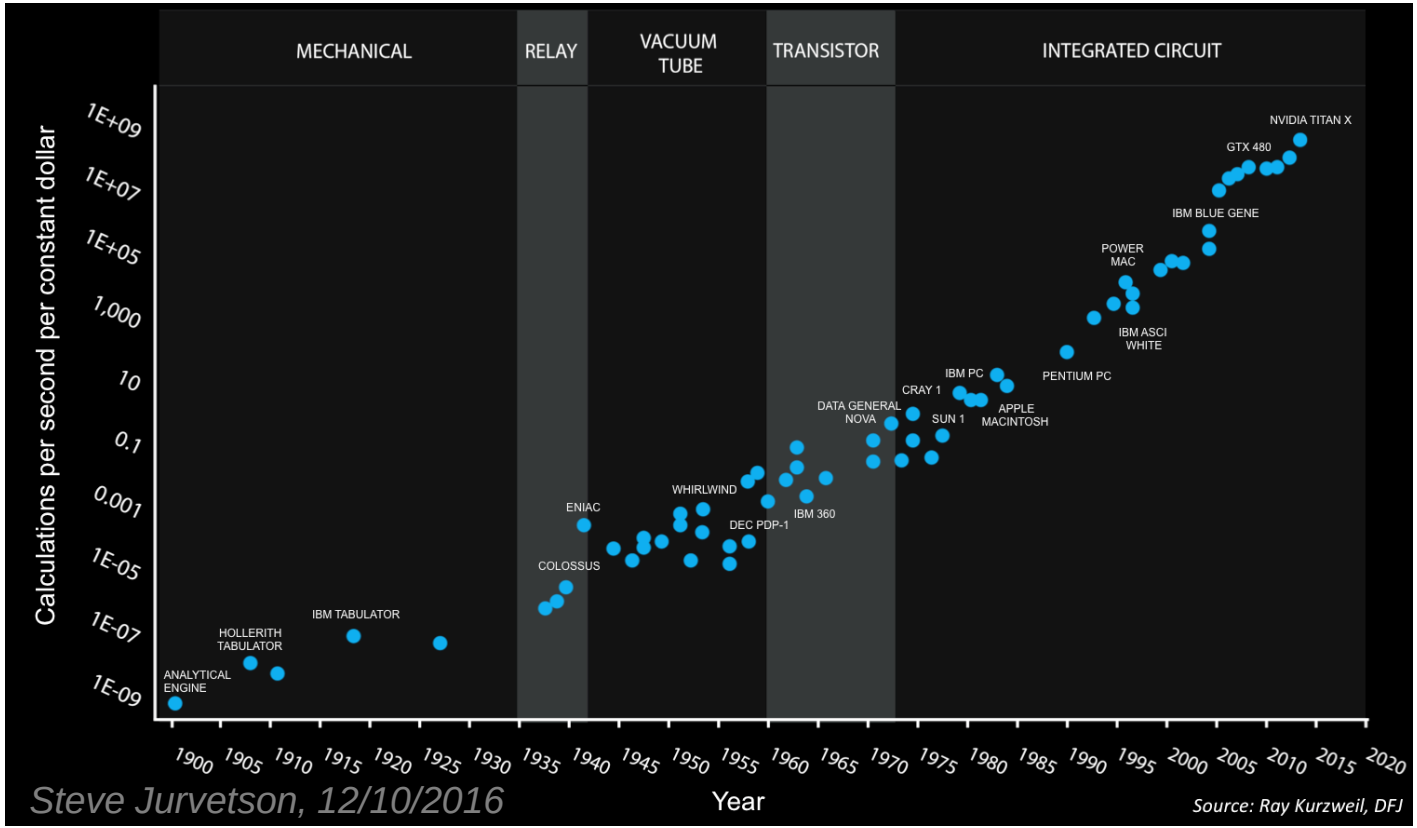
PJ Lamberson, John Lang, Noshir Contractor, Leslie DeChurch, and Brian Uzzi

July 12, 2017

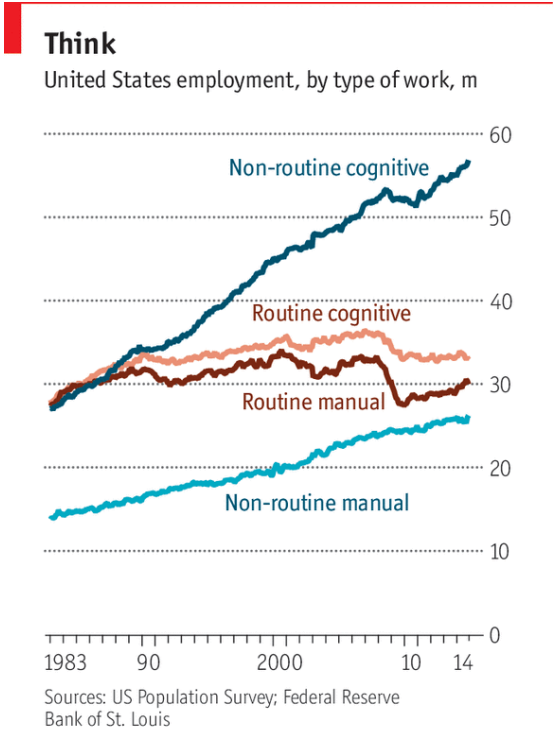
IC^{2}S^2 2017

NIH R01 GM112938-02

Moore's Law


MECHANICAL
RELAY
VACUUM TUBE
TRANSISTOR
INTEGRATED CIRCUIT
Calculations per second per constant dollar
1E+09
1E+07
1E+05
1,000
10
0.1
0.001
1E-05
1E-07
1E-09
ANALYTICAL ENGINE
HOLLERITH TABULATOR
IBM TABULATOR
COLOSSUS
ENIAC
WHIRLWIND
DEC PDP-1
IBM 360
DATA GENERAL NOVA
CRAY 1
IBM PC
SUN 1
APPLE MACINTOSH
PENTIUM PC
IBM ASCI WHITE
POWER MAC
IBM BLUE GENE
GTX 480
NVIDIA TITAN X
1900 1905 1910 1915 1920 1925 1930 1935 1940 1945 1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020
Year
Steve Jurvetson, 12/10/2016
Source: Ray Kurzweil, DFJ

The Future of Work



Economist, 06/25/2016

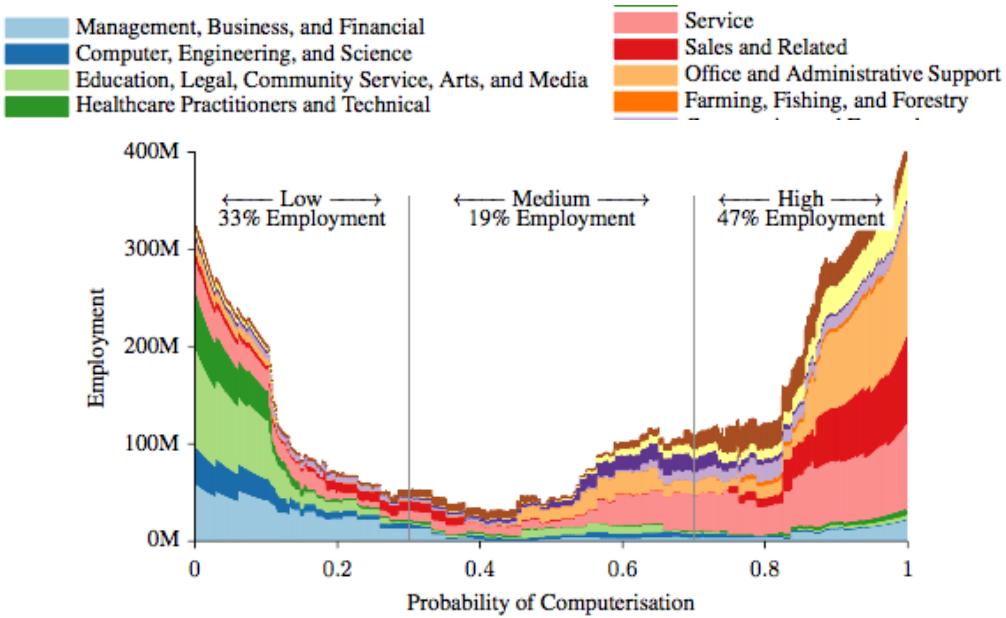


FIGURE III. The distribution of BLS 2010 occupational employment over the probability of computerisation, along with the share in low, medium and high probability categories. Note that the total area under all curves is equal to total US employment.

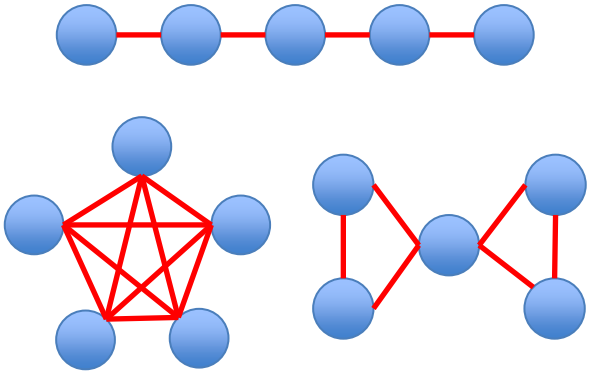
CB Frey, MA Osborne (2017). *Technological Forecasting and Societal Change* 114: 254—280

Teamwork

What makes a good team?

Composition

Communication Network



Communication Network

Lazer & Friedman (2007)

"… the **more efficient the network** at disseminating information, the **better the short-run** but the **lower the long-run** performance of the system."

Mason & Watts (2012)

"… **efficient networks** perform **unambiguously better** than inefficient networks…"

More exploration = Better performance

Agents should primarily work on their own

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Communication Quality

Sharing Solutions

An agent can copy the position of a better performing neighbour

Sharing Perspectives

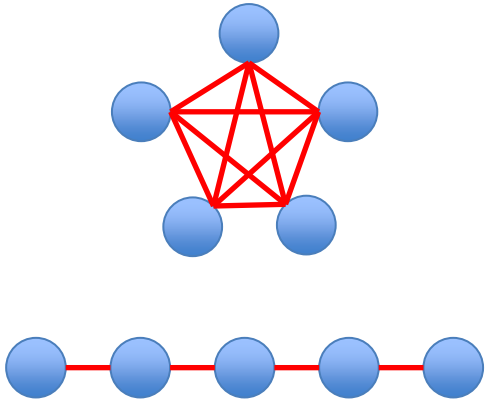
An agent can ask a neighbour what solutions they would try if they were in the same position

Teamwork

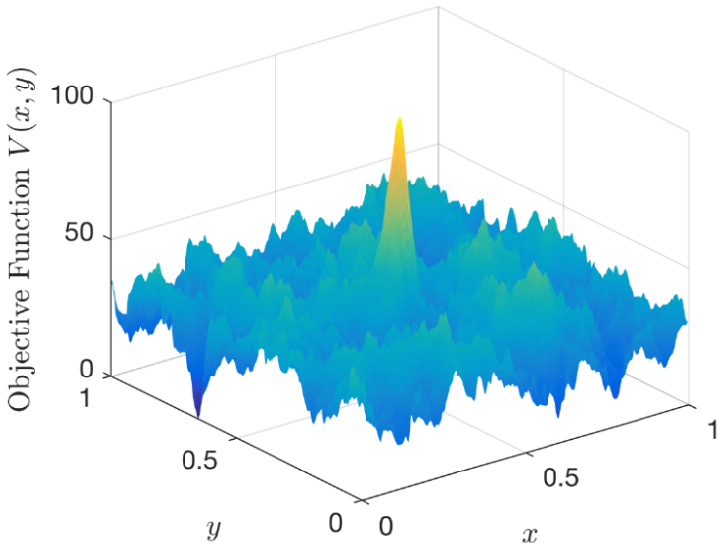
What makes a good team?

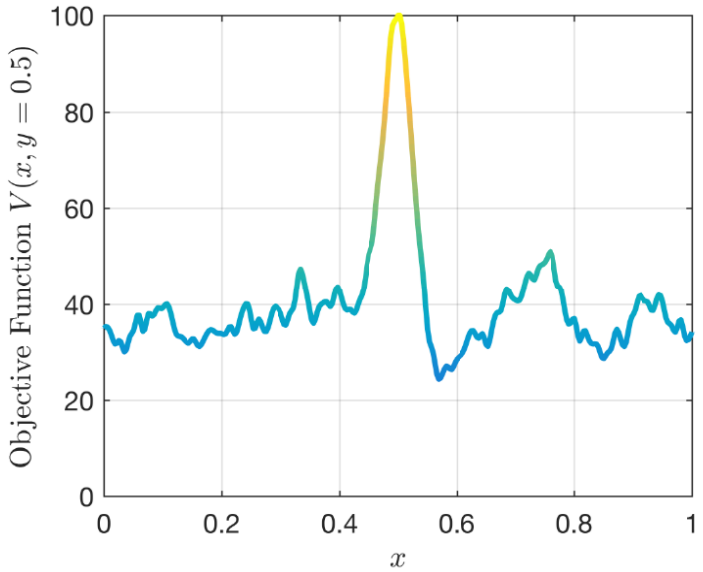
Communication Quality

Communication Network

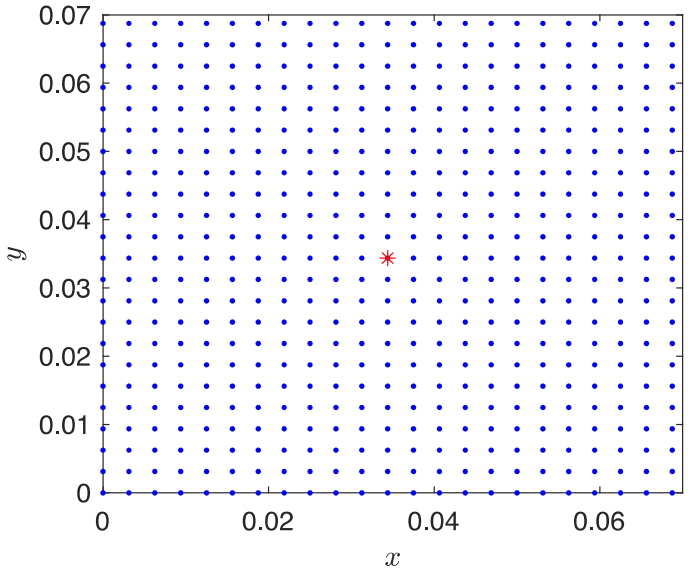


Problem Space





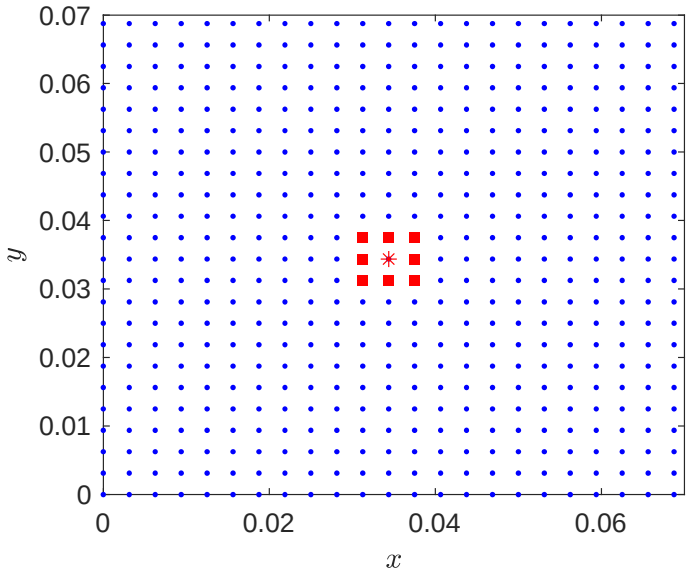
Perspective Space



Agent with RED perspective

✳ - Initial condition

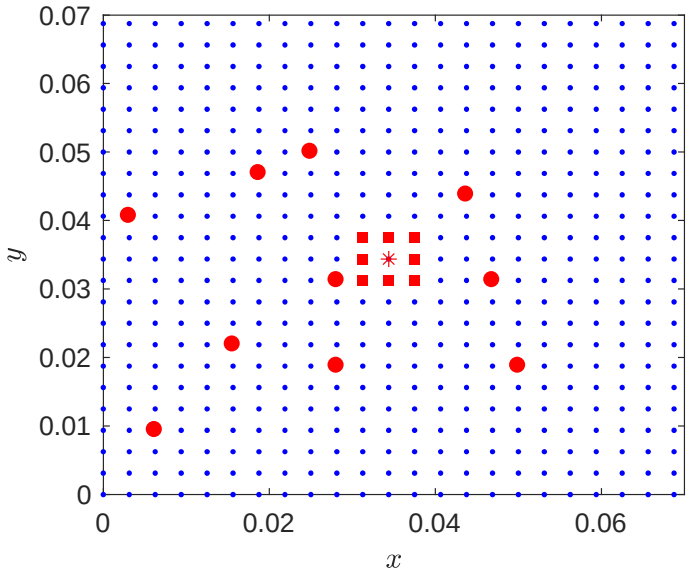
Perspective Space



Agent with RED perspective

✳ - Initial condition □ - Local search

Perspective Space

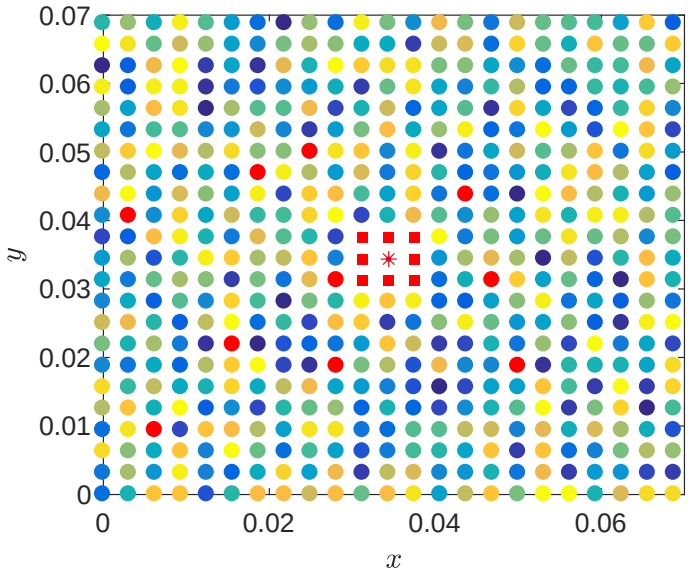


Agent with RED perspective

✳ - Initial condition □ - Local search

● - Specialized search

Perspective Space



Agent with RED perspective

✳ - Initial condition □ - Local search

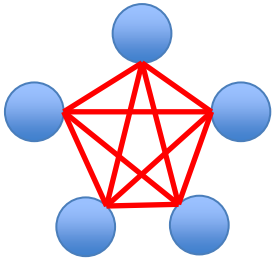
● - Perspective search

Teamwork

What makes a good team?

Communication Quality

Communication Network



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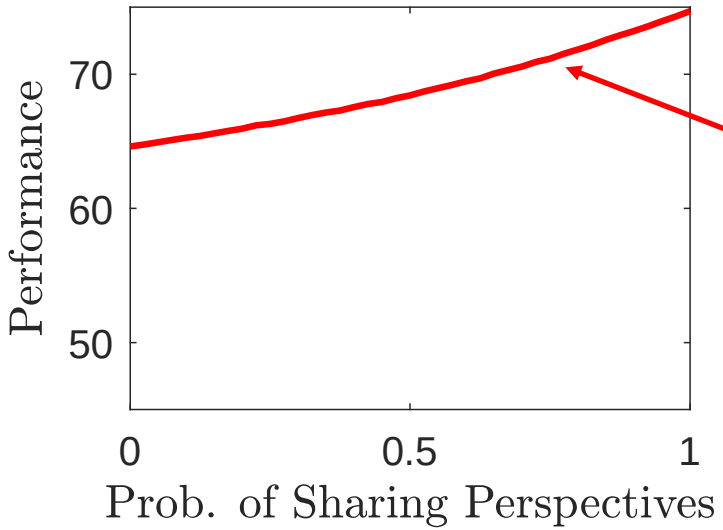
Perspective vs. Location



Fully Connected Network (Best Performing Agent)

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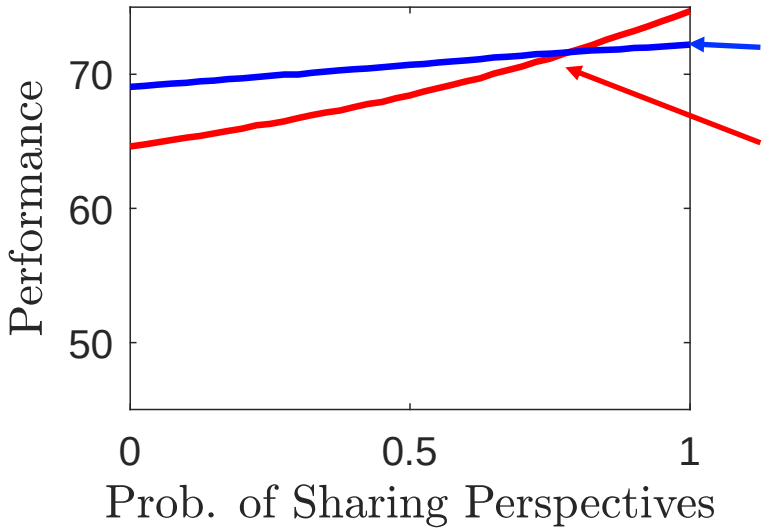
Perspective vs. Location



Linear Network (Best Performing Agent)

Fully Connected Network (Best Performing Agent)

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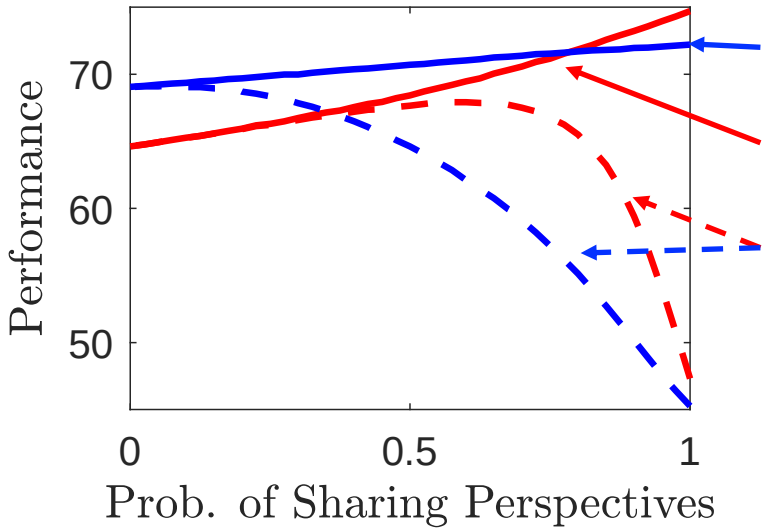
Perspective vs. Location



Linear Network (Best Performing Agent)

Fully Connected Network (Best Performing Agent)

Average Team Performance

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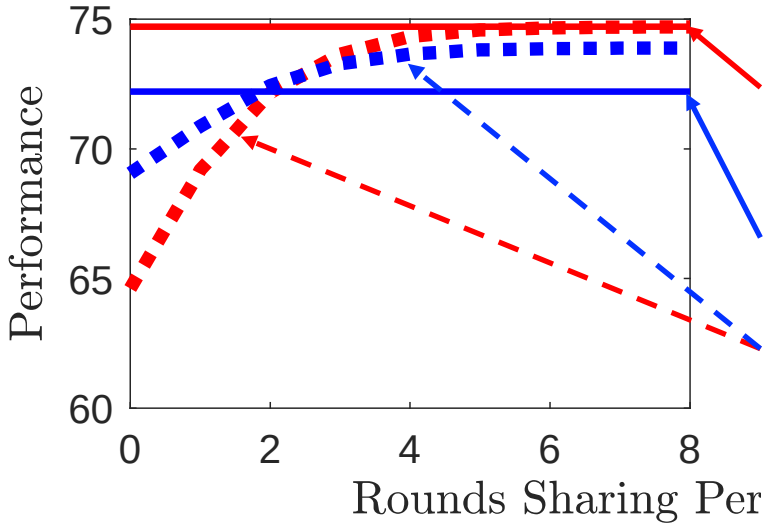
Perspective ☞ Location



Fully Connected Network (Best Performing Agent, Copy Perspectives Only)

Linear Network (Best Performing Agent, Copy Perspectives only)

Average Team Performance

Conclusion

Effect of Network Structure on Team Performance:

- Depends on type of communication.
- When copying locations (solutions) then inefficient networks are better.
- When copying perspectives (strategies) then efficient networks are better.
- Exploration increases chance of finding high payoff solutions

Improved Team Heuristic

- Exploration: In early stages copy perspectives (strategies).
- Exploitation: In late stages copy locations (solutions).

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Thank You