

Hybrid computing using a neural network with dynamic external memory

A. Graves et al

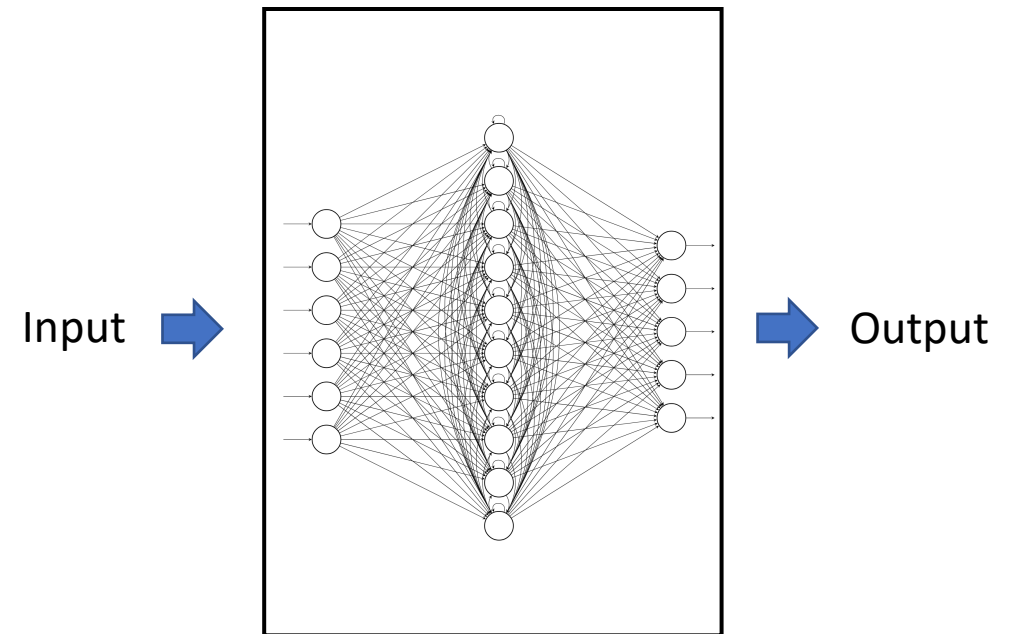
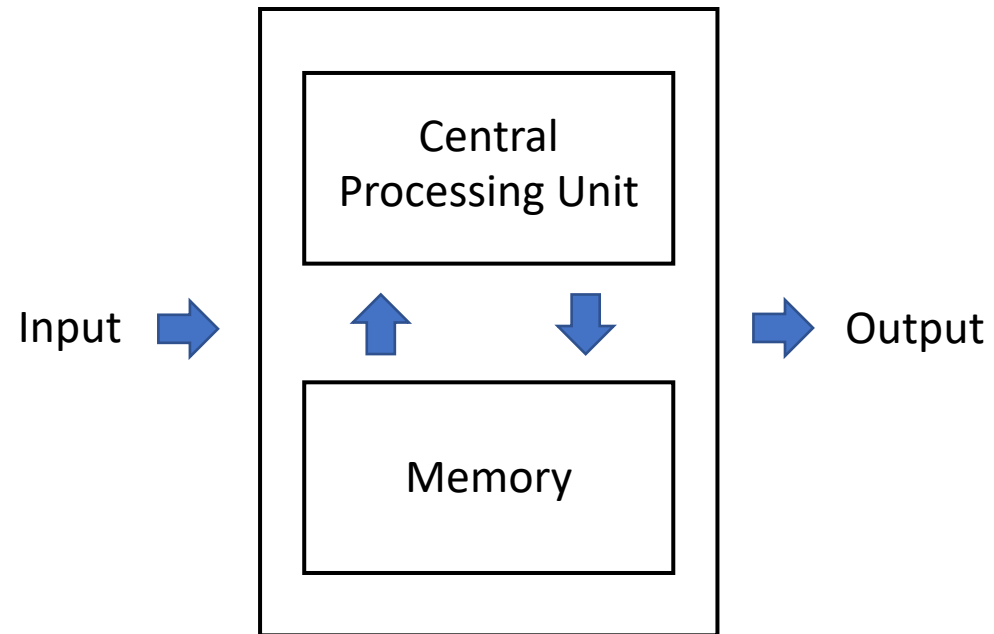
CIML Reading Workshop

Daniele Di Sarli

Feb 26, 2020

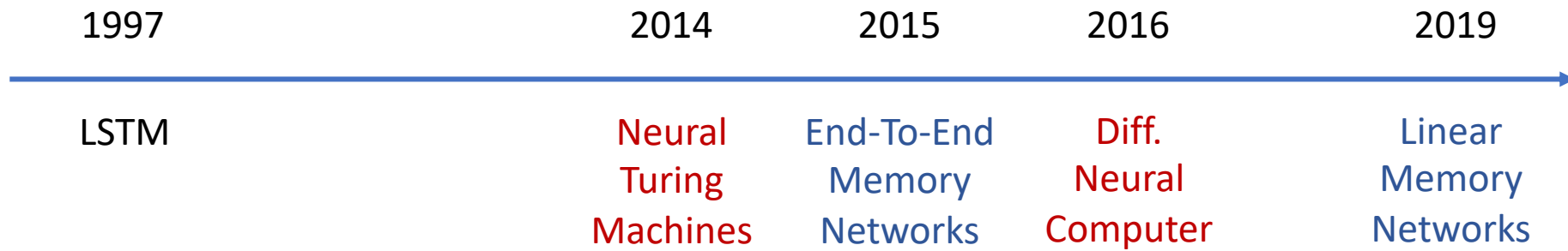


Problem, Motivations



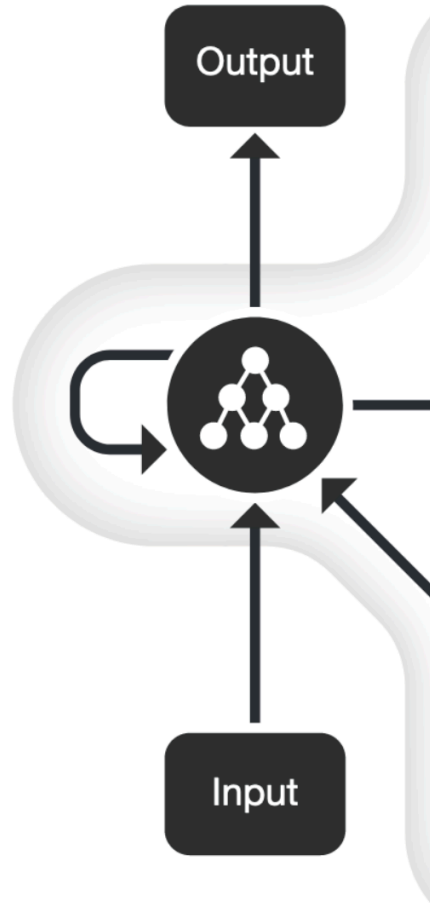
Background

- S. Hochreiter, J. Schmidhuber: **Long Short-term Memory**
- A. Graves et al: **Neural Turing Machines**
- S. Sukhbaatar et al: **End-To-End Memory Networks**
- A. Graves et al: **Hybrid computing using a neural network with dynamic external memory**
- D. Bacciu, A. Carta, A. Sperduti: **Linear memory networks**

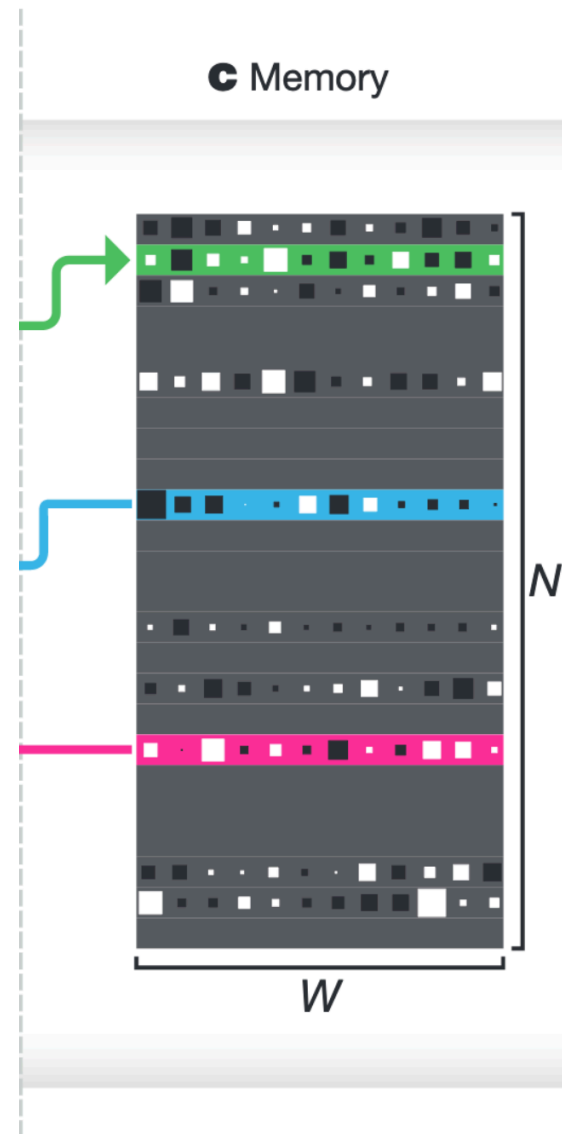
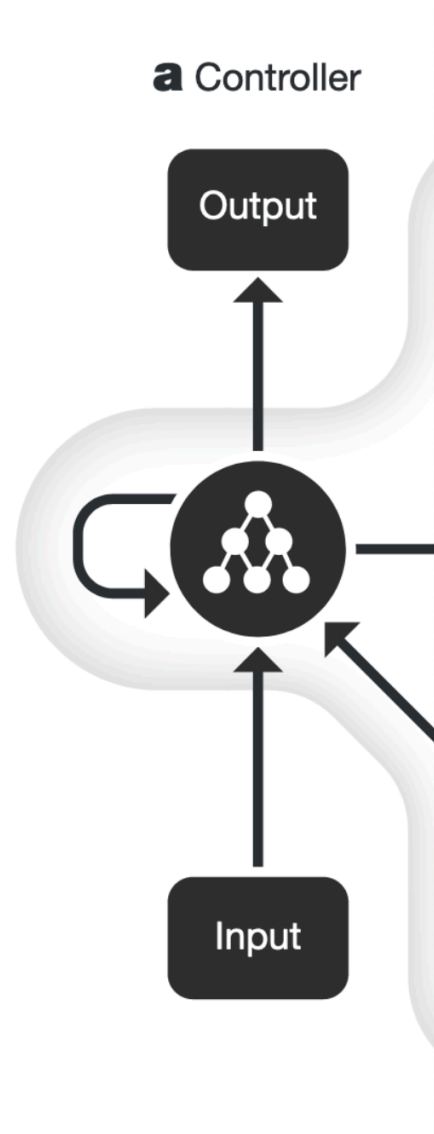


The DNC

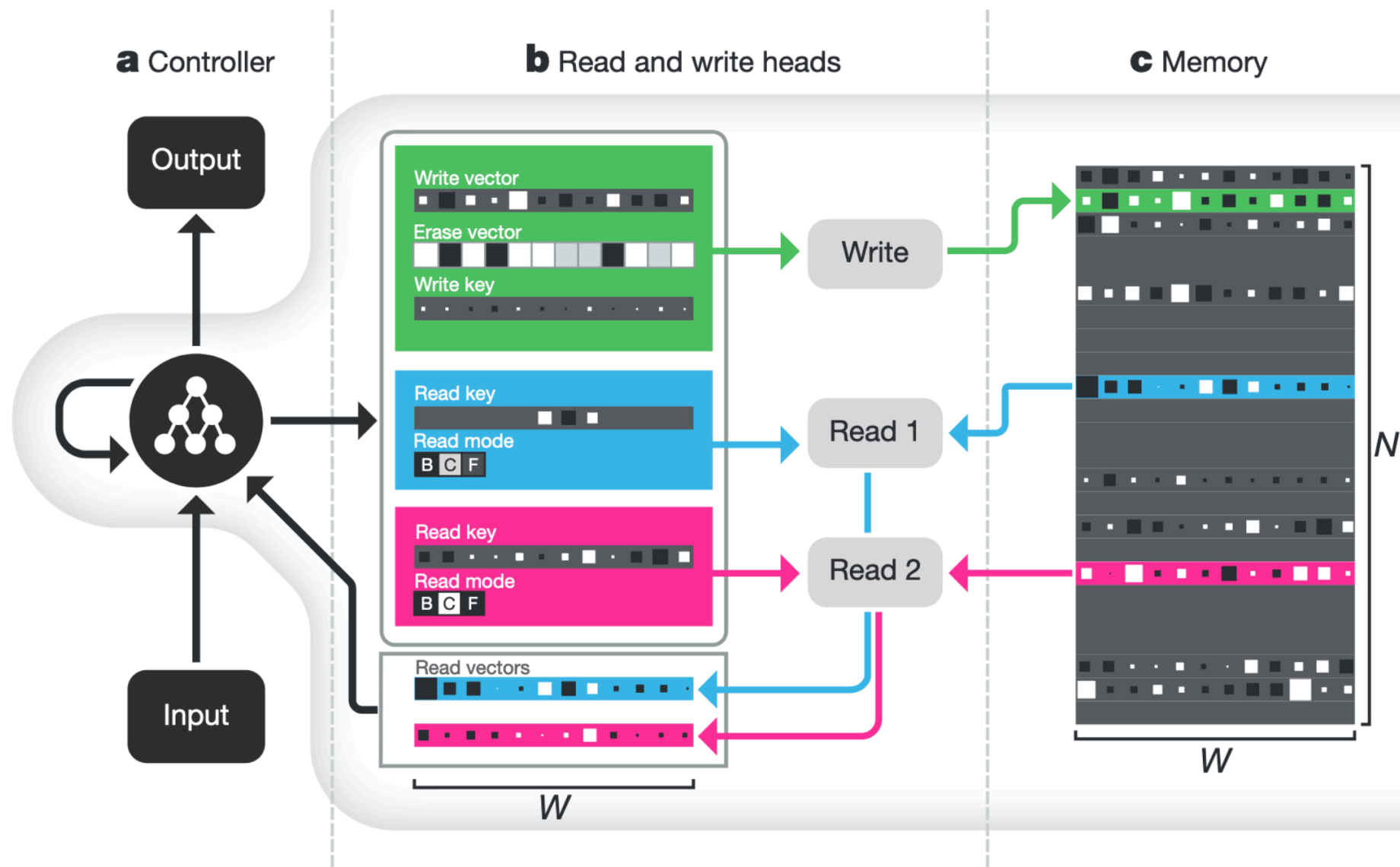
a Controller



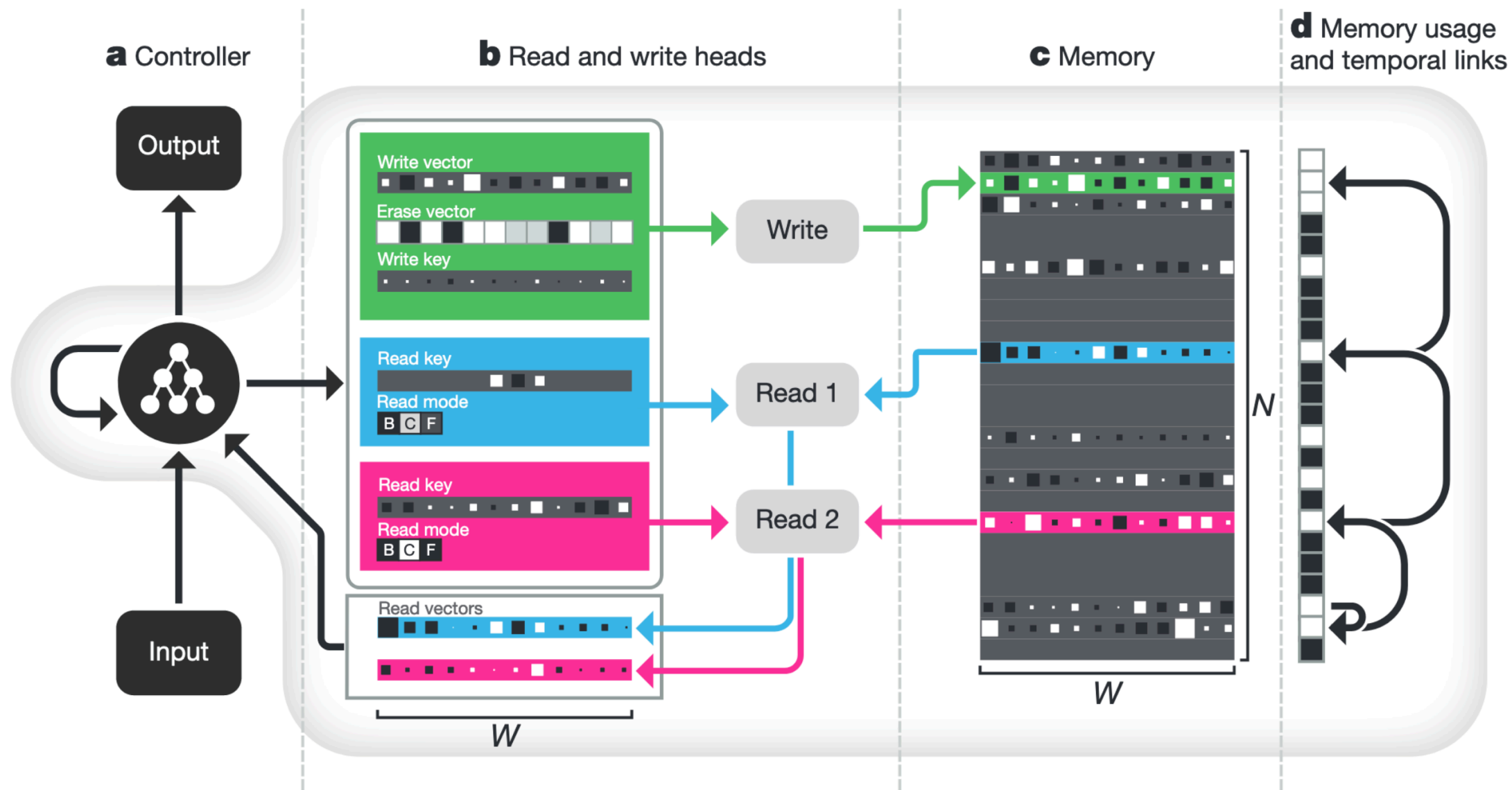
The DNC



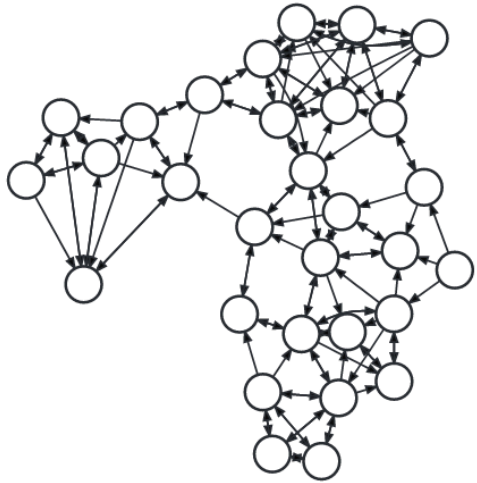
The DNC



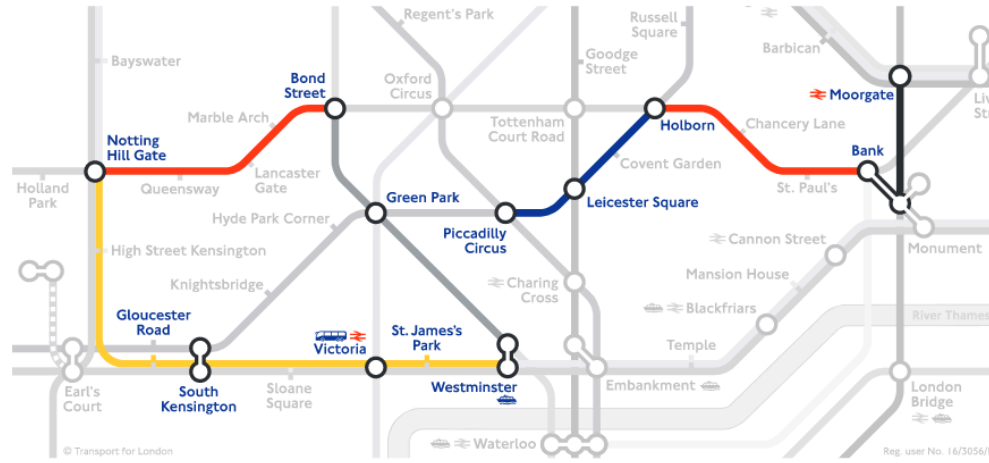
The DNC



a Random graph



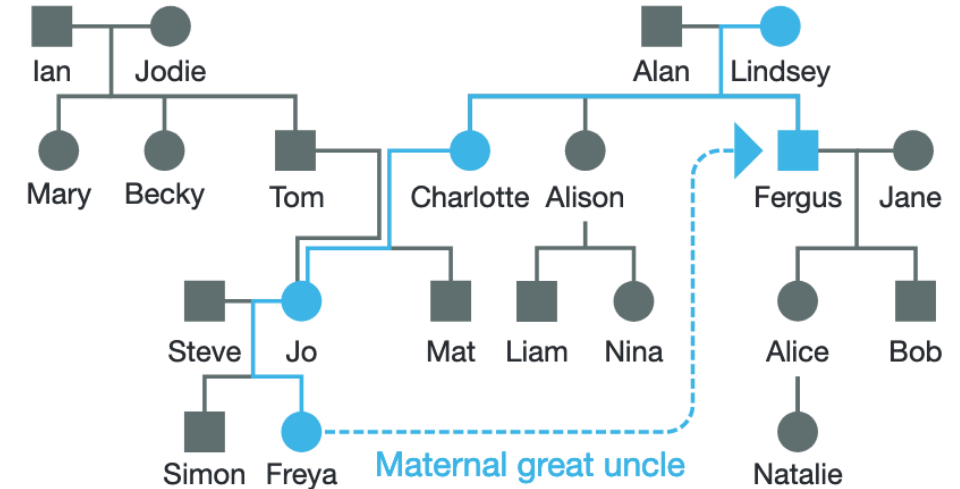
b London Underground



Traversal

Shortest-path

c Family tree



Underground input:

- (OxfordCircus, TottenhamCtRd, Central)
- (TottenhamCtRd, OxfordCircus, Central)
- (BakerSt, Marylebone, Circle)
- (BakerSt, Marylebone, Bakerloo)
- (BakerSt, OxfordCircus, Bakerloo)
- ⋮
- (LeicesterSq, CharingCross, Northern)
- (TottenhamCtRd, LeicesterSq, Northern)
- (OxfordCircus, PiccadillyCircus, Bakerloo)
- (OxfordCircus, NottingHillGate, Central)
- (OxfordCircus, Euston, Victoria)

84 edges in total

Traversal question:

- (BondSt, _, Central),
- (_, _, Circle), (_, _, Circle),
- (_, _, Circle), (_, _, Circle),
- (_, _, Jubilee), (_, _, Jubilee),

Answer:

- (BondSt, NottingHillGate, Central)
- (NottingHillGate, GloucesterRd, Circle)
- ⋮
- (Westminster, GreenPark, Jubilee)
- (GreenPark, BondSt, Jubilee)

Shortest-path question:

- (Moorgate, PiccadillyCircus, _)

Answer:

- (Moorgate, Bank, Northern)
- (Bank, Holborn, Central)
- (Holborn, LeicesterSq, Piccadilly)
- (LeicesterSq, PiccadillyCircus, Piccadilly)

Family tree input:

- (Charlotte, Alan, Father)
- (Simon, Steve, Father)
- (Steve, Simon, Son1)
- (Nina, Alison, Mother)
- (Lindsey, Fergus, Son1)
- ⋮
- (Bob, Jane, Mother)
- (Natalie, Alice, Mother)
- (Mary, Ian, Father)
- (Jane, Alice, Daughter1)
- (Mat, Charlotte, Mother)

54 edges in total

Inference question:

- (Freya, _, MaternalGreatUncle)

Answer:

- (Freya, Fergus, MaternalGreatUncle)

Bibliography

- Graves, Alex, et al.
Hybrid computing using a neural network with dynamic external memory.
Nature (2016): 471-476.
- Graves, Alex, Greg Wayne, and Ivo Danihelka.
Neural turing machines.
arXiv preprint arXiv:1410.5401 (2014).