A big rectangle filled with little rectangles. All the red rectangles have integer height. (For example, the bottom-left red rectangle has height 8.) All the green rectangles have integer width.

A number of small rectangles perfectly tile a big rectangle. If the small rectangles all have the property that at least one of their sides is an integer, can you show that the big rectangle also has at least one integer side? That is, either the width of the big rectangle is an integer, or its height is an integer, or both.

[If you have a proof for the case 'integer', how about 'rational'?]
The Thinking Machine?

- **Algorithms (normative)**
  - Bayes' theorem
  - Bellman equation

- **Biological machines**
  - Their motor skills, and tactile feedback
  - Molecules
  - Spatial/temporal memory
  - Grammar

- **Artificial machines**
  - Categorizing movies or images
  - Learning for games
  - Separating the sheep from the bikes
  - Proofs and Diagrams
  - Is there anything computers can't do?

- Left anything out?

'It's not listening. - It's just following a recipe'
Have we left anything out?

- Timing?
- Content-addressable memory?
Content-addressable memory

Shaken, not...
Content-addressable memory

An author
Content-addressable memory
Content-addressable memory

- How to do it?
- How do brains do it?
Shown 725 images

- instructed to memorize labels "+/-"

What is the difference between

a pigeon and a supercomputer?
Amount of hardware?

**Pigeon**
- $10^9$ neurons
- $10^{12}$ synapses
- $10^{15}$ proteins

**Pentium**
- $50 \times 10^6$ transistors (CPU)
- $10^{12}$ transistors (RAM)

Clock rate

**Pigeon**
- $10^9$ neurons, 100 Hz
- $10^{12}$ synapses, 100 Hz
- $10^{15}$ proteins, 0.1 Hz

**Pentium**
- $50 \times 10^6$ transistors (CPU), $10^9$ Hz
- $10^9$ transistors (RAM)

- $10^{14}$ device-ops/sec
- $10^{16}$ device-ops/sec
Parallel Distributed Processing
Thank you

to Liam Garvey, Jo Ryan

and the Horizons team
Two proofs accessible to a ten-year-old

A big rectangle filled with little rectangles. All the red rectangles have integer height. (For example, the bottom-left red rectangle has height 8.) All the green rectangles have integer width.

'14 Proofs of a theorem about tiling a rectangle' - S. Wagon