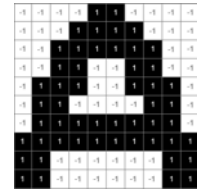


Minds and Machines(cont.)

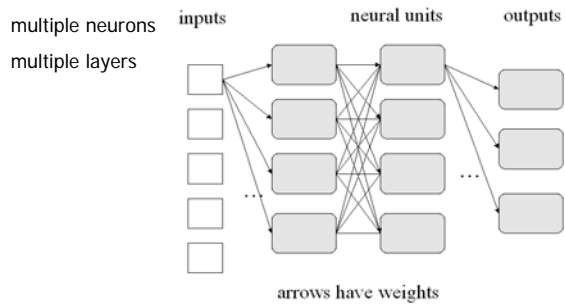
June 4, 2007
KangKang Yin

Pattern Recognition

- ▶ the set of inputs which cause the network to output "1" is the *pattern* it recognizes
- ▶ Handwriting recognition
- ▶ Fingerprint recognition
- ▶ Face recognition



artificial neural networks



Designing Neural Nets: example



- ▶ input is the binary colour of each square
- ▶ output= "1" on input 1001
- ▶ output= "0" on all other inputs

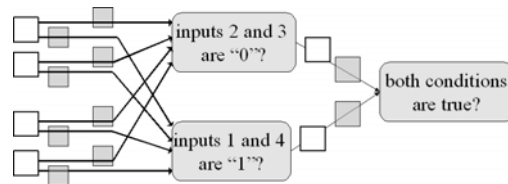
pseudocode to recognise checkered pattern

```

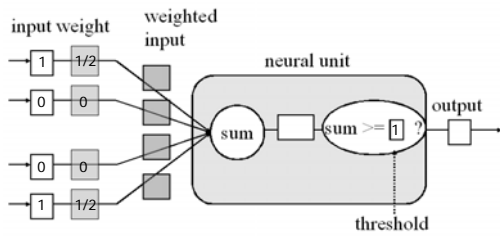
if ((input 1 == 1) and (input 2 == 0) and
    (input 3 == 0) and (input 4 == 1))
    { output "yes"; }
else
    { output "no"; }
    
```

neural network to recognize checkered pattern

Let's try 2 layers, 3 neurons

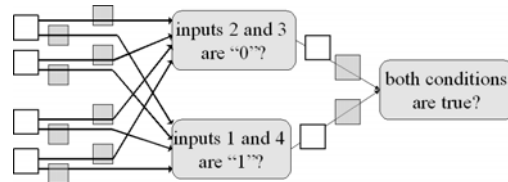


unit for "inputs 1 and 4 are 1?"



Try: weights of 0 for the "irrelevant" inputs;
weights of 1 for the "relevant" inputs 1 and 4;
threshold of 1.

Now you know how to complete the Neural nets?



example to think about

- ▶ recognizing a more general checkerboard pattern:



- ▶ 1001 and 0110 are checkerboards; other inputs are not

In real-life applications

NNs are learned through training,
optimization, evolution

More about training shortly

So where is the algorithm?

- ▶ *implicit* in the weights and connections!
- ▶ whereas in a computer program, the algorithm is a sequence of instructions

algorithm types

- ▶ *procedural* algorithms
 - arithmetic algorithms
 - search and sort
 - generative systems
- ▶ *Connectionist* algorithms
 - neural networks
 - symbolic learning
 - genetic algorithms
- ▶ connectionism vs. computationalism
 - models mental or behavioral phenomena as the emergent processes of interconnected networks of simple units; strong learning component
 - mental activity is computational; the mind operates by performing purely formal operations on symbols

Learning

- ▶ the brain learns
- ▶ the algorithm (choice of weights) is not hard-wired into the brain
- ▶ learning occurs by changing the weights so that the influence of one neuron on another changes

Learning through training

- ▶ NNs can be *trained*
 - training examples
 - weights adjusted so that the network gives the correct output on the training examples
 - adapt to new data

summary: computer science and psychology

- ▶ psychologists and computer scientists work together to ...
 - design better interfaces to software
 - figure out how computers might perform complex tasks, e.g., recognising a scene, navigate unknown terrain
 - to understand how the brain processes information

what do you think?

- ▶ what potential do you see for more collaboration between ... ?
- ▶ what are the pitfalls?