How do computers become so clever?

Computers do some miraculous things. A computer can beat the world champion at chess, even fly a plane more skillfully than a human. How do they do it? How can a lump of silicon and wire appear to be cleverer than a human? Everything that a computer does that is intelligent is ultimately down to a person – a computer scientist in fact – writing clever instructions: rules to be followed. Everything you have ever seen a computer do, was just the result of it obeying the rules written by a computer programmer years earlier. Even a piece of paper can play these games as well as humans if it contains such rules. In fact:
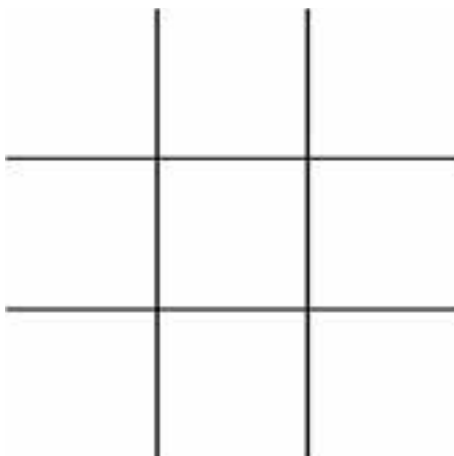
This piece of paper (let's call it Pete) can play better noughts and crosses than you can!

You will struggle to beat Pete at any rate! Try.

The instructions below give you a list of the moves that Pete the paper makes. If you are playing against Pete, you make whatever move you want to make after each one of Pete's moves. Pete gets to go first and is X. Follow his instructions as they are written.

Pete's Move 1:
Draw an X in a corner for me.

Your Turn:
Go where you like.

Pete's Move 2:
If no-one went there already then draw an X in the opposite corner to my move 1.

Otherwise put an X in a free corner for me.

Your Turn:
Go where you like.

Pete's Move 3:
If there are two Xs and a space in a line (in any order) then put an X in that space. I win!

Otherwise if there are two 0s and a space in a line then put an X in that space. Ha!

Otherwise put an X in a free corner for me.

Your Turn: Go where you like.

Pete's Move 4: If there are two Xs and a space in a line (in any order) then put an X in that space. Gotcha! I win!

Otherwise if there are two 0s and a space in a line then put an X in that space for me.

Otherwise put an X in a free corner.

Your Turn:
Go where you like.

Pete's Move 5:
Put an X in the free space for me.

Why not use Pete's moves above when you next have a game with your friends.

Obviously, if you're playing against friends, Pete's moves are the moves you make and your friend will make the moves labelled 'Your turn'. You will be invincible.

This is all a computer program is – a list of instructions that the computer can follow. The instructions for the computer have to be written very precisely in special languages so that the computer can follow them without understanding them, but the idea is the same.

Computers can only do things that the programmer has thought of – if things aren't as expected it won't seem so clever. I wrote the above rules expecting the paper to go first but what if it has to play second? Does it still seem so clever? That is the skill of the programmer: writing rules for every eventuality. Have a go at writing some better instructions for player 2 at noughts and crosses.

Quick facts

By the beginning of the 1990s, a Hallmark greeting card embedded with a microchip that allowed the card to play 'Happy Birthday' contained more computing power than existed on the entire planet in the early 1950s. The one I got for my last birthday played 'Agadoo'…Arrghhhh!