A Turing Robot (unpublished)

A Turing Robot is proposed as a model for a computer interacting with the real world. It is asserted, as an invitation for refutation, that a Turing Robot is more powerful than a classic Turing Machine.

The classic *Turing Machine (TM)* has a finite-state controller with a read-write head that moves along a potentially infinite tape.

A *potentially infinite tape* is a finite string of cells, the contents of which can be read and written to by a read-write head, and which is automatically extended by one blank cell whenever the read-write head reaches the current end cell. (This is a practical implementation of the classic Turing Machines's infinite tape. It is assumed here that the tape is infinite in one direction only as bidirectional infinity has been shown to be unnecessary.)

The *Turing Robot (TR)* has a finite-state controller with a read-write head that moves along a potentially infinite **interactive** tape, the tape being coupled to an environment or external world.

A *potentially infinite interactive tape* is a string of cells, the contents of which can be read and written to by a read-write head, and which is automatically increased by a triple of cells whenever the read-write head reaches the current end cell. The 3 cells of a triple are specified as follows. The first cell contains an input symbol, derived from the environment. The second cell is blank and is equivalent to the normal extension of a potentially infinite tape as used by a TM. The third cell is an output cell and contains a special symbol, say O, to indicate that it is the new end or omega cell. When the read-write head reaches an omega cell, it reads the O and, if it writes a symbol into the cell, that symbol is output to the environment. If the read-write head moves from the omega cell without writing, then a null is output to the environment and the omega cell becomes a normal blank cell. In either case, the omega cell ceases to be an omega cell.

Comments and Assertions

1. The second blank cell supplied with each triple is intended to provide as much working tape as might be needed. This is similar to the way Turing alternated output cells and working cells in an example in his original 1936 paper.

2. The TR becomes a TM if the input cell of each triple is a blank, the special symbol in an omega cell is a blank, and the TR is required to halt. Hence the TR is at least as powerful as a TM.

3. The TR differs from the TM in that it has a potentially infinite input, while the input data of a TM has to be finite or finitely described, and it has to be given when the TM is 'switched on'.

4. A computer normally behaves like a TR when it is processing real world information. Sensors in the real world provide it with a potentially infinite input and it displays, saves or prints out a potentially infinite output.

5. If a finite length of the input/output sequence of a TR were found for some interaction, then a TM could be designed to generate the same input/output sequence given the input sequence.

6. A TM could generate the input/output sequence of a TR interacting with another TR, given the finite initial description of the two TRs.

7. Two TRs interacting with each other in a closed system have no more power than a single isolated TR. Similarly, a computer interacting solely with another computer is equivalent to a single isolated computer.

8. It may be conjectured that a brain interacting solely with another brain would also be no more powerful than a single isolated brain.

9. Consider a family of *Lifetime Turing Robots (LTRs)* that interact with each other and with the real world. Each LTR in the family is a TR with a finite lifetime, but thelifetimes of the family overlap so that the family exists continuously over a potentially infinite period. The LTRs extract information from the real world, process infrmation, exchange information with each other, and pass it on to 'younger' LTRs.

10. An LTR existing a while after the beginning of the family of LTRs could have 'knowledge' that had come to it through generations of LTRs.

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