

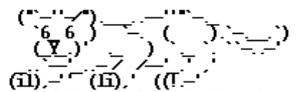
# Celebrating 50 years of computing at the Rutherford Appleton Laboratory: Exhibit captions



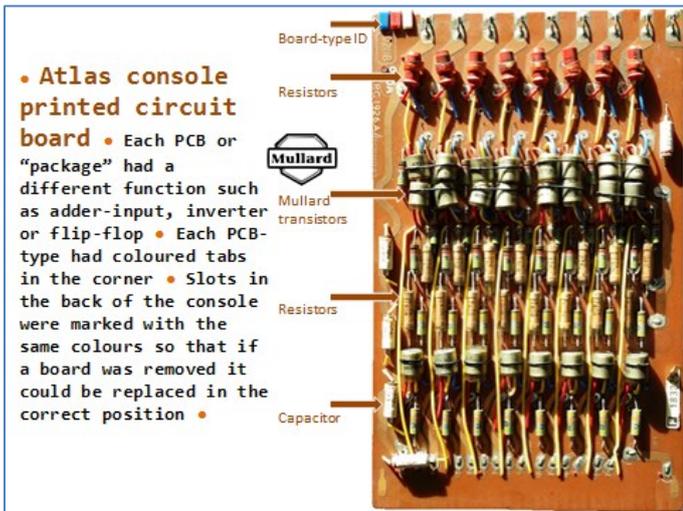
• Big data in 1968 • A plate from the Data Products disc store attached to Atlas • There were 16 plates in all • Each plate held about 6 megabytes of data •

Modern coffee mug for size comparison

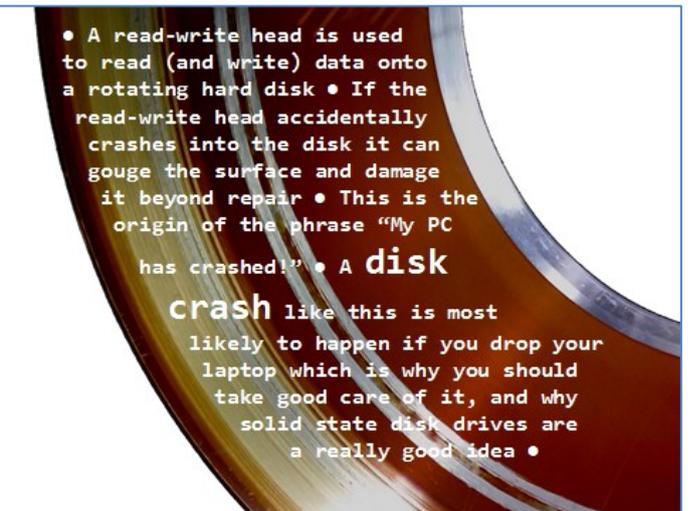
• Before the 1980s, printer output was onto "fan-fold" paper with perforations between each sheet • Sprocket holes down the sides enabled the line-printer to guide the paper through the machine • Only letters, punctuation and digits could be printed so pictures were created using **ASCII art** • A form of this is still in use today :-)



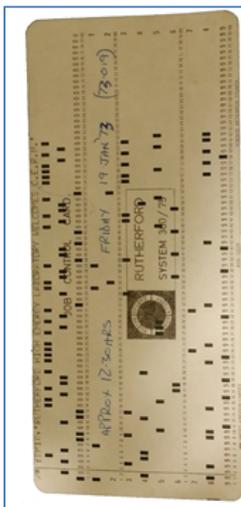
• ASCII: American Standard Code for Information Interchange



• Atlas console printed circuit board • Each PCB or "package" had a different function such as adder-input, inverter or flip-flop • Each PCB-type had coloured tabs in the corner • Slots in the back of the console were marked with the same colours so that if a board was removed it could be replaced in the correct position •



• A read-write head is used to read (and write) data onto a rotating hard disk • If the read-write head accidentally crashes into the disk it can gouge the surface and damage it beyond repair • This is the origin of the phrase "My PC has crashed!" • A **disk crash** like this is most likely to happen if you drop your laptop which is why you should take good care of it, and why solid state disk drives are a really good idea •



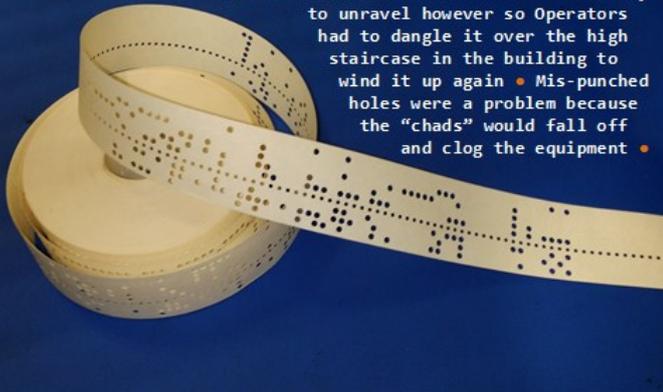
• Computer programmes written by users were often posted to Atlas as a deck of **punched cards** • One card held one line of programme • The first few cards contained JCL (Job Control Language) which specified the resources required for that job such as files on magnetic tape or line-printer output • It was the Operator's job to review the JCL, schedule jobs so that they did not clash over resources, ensure that the tape drives were loaded ready to go, remove output from the printer, load the next deck of cards into the card reader, and make the tea •

• Users had a choice of **programming languages** including • ABL (Atlas Basic Language) and EMA (Extended Mercury Autocode) for frequently-used subroutines which needed to be fast • ALGOL, the language used in most universities at the time • or HARTRAN, a version of IBM's FORTRAN language adapted for the Atlas hardware • Some programmes would run for the best part of a day; others took just a few seconds (but this was usually because they failed to compile) •

```

0001 C FORTRAN COMMENT
0002 INTEGER FUNCTION XF(YF)
0003 COMMON / YF / Q, NO // Z(4) / COM
0004 COMMON / YF / MCRF
0005 C=0
0006 I 0 DIMENSION S(12),FORMAT(8),Q(NO)
0007 DIMENSION ZELUS(1,8)
0008 C
0009 EQUIVALENCE (ZELUS(4(1),Z(1),NW,V)
0010 B(I)-S(I)
0011 +=I
0012 DATA FB / 1H /
0013 COM(X) = (1,0)
0014 C(J) = FLOAT(J) + 9.0
0015 60 TAN(X) = SIN(X) / COS(X)
0016 C#
0017 ZELUS 4(2,1) = 99999.
0018 X = 0.0
0019 WRITE(6,100)
0020 1000 FORMAT(/ZK,AL.(3(2 H )))
0021 TOT = 0
0022 RV = FB
0023 NW = 0
0024 C
0025 DO 1 I = 2,4
0026 DATA FORMAT / @*0.0 /
0027 1 TOT = TOT + FORMAT(I)
0028 I = 1
0029 IF(YF.NE.(YF*YF)/YF) GOTO 9
0030 C
    
```

- **Punched paper tape** was often used instead of cards when posting programmes to Atlas as it was lighter and easier to handle • It did have a tendency to unravel however so Operators had to dangle it over the high staircase in the building to wind it up again • Mis-punched holes were a problem because the "chads" would fall off and clog the equipment •



- Staff in the **Program Advisory Office (PAO)** kept a log book of jobs submitted by users
- If a job failed they tried to work out what was wrong, corrected, then resubmitted it • The log book included a two-letter university ID for accounting purposes, the user's code and name, a description of the job, and a date stamp •

*VQ064 Hughes Harton Ariel 3 Project. Assemble further run. Computer AUG 1968*

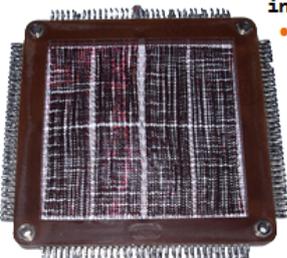
- Job **VQ064** was submitted in August 1968 by Arthur Hughes at Sheffield University and related to **Ariel 3**, the first ever all-British satellite •
- Ariel 3 was launched in 1967 to collect data for a variety of projects on behalf of the Universities of Sheffield and Birmingham, and for the Met Office • It orbited Earth every 95 minutes and relayed information back to a computer at Slough's Radio and Space Research Station • It was shut-down in 1969, and finally re-entered Earth's atmosphere in 1970 •



- **Masstor M860 tape** • Each tape was 20 metres long and had a capacity of 175 megabytes • Data could be retrieved in about 20 seconds • After use, tapes were rolled back into the cartridge automatically
- 300 cartridges were stored in a honeycomb of "Storage Modules" • Each module could store over 50 gigabytes of data •



- **Atlas core memory** consisted of about 600 Bakelite frames manufactured by Plessey • Each frame contained a grid of thin wires with a (magnetic) ferrite doughnut-shaped core at each junction • Each core represented one bit and could be magnetised clockwise or anticlockwise to indicate a binary "0" or "1"
- There were 4096 cores per frame, but so much error checking was needed that each frame actually represented less than half a kilobyte •



**If Creeper, Zero, Blue Stripes, Future Warrior and Tetris stood on each other's heads...**

And if their combined 10 metre height represented the 2 gigabytes of memory in a teeny little iPod Shuffle then, proportionally speaking...

128 megabytes of memory in the Cray X-MP would come up to Tetris' waist

2 megabytes of memory in the IBM 360/195 would come up to Tetris' ankle

0.3 megabytes of memory in Atlas would be less than the thickness of Tetris' toenail

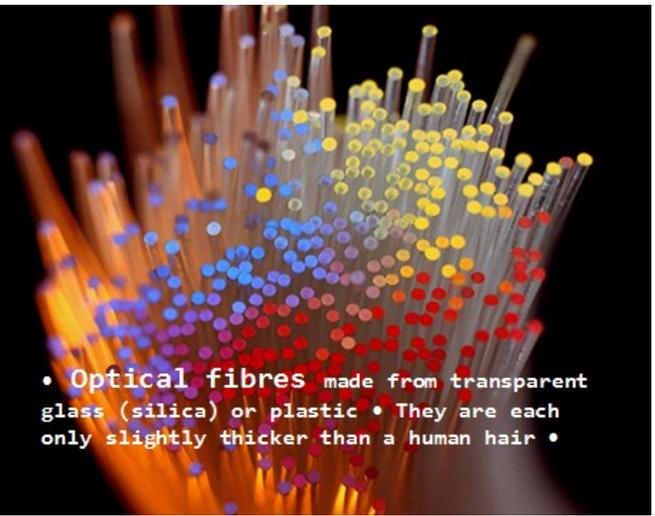



- **JANet** (the Joint Academic NETWORK) is a UK government-funded organisation which provides networking to UK research and education institutes
- If you want to set up a .ac.uk or .gov.uk domain then talk to JANet • It has laid more than 5,000km of **armoured 12-core optical cable** like this from Lands End to John O'Groats, serves over 18,000,000 users, and runs at 100Gbits/second • We are neighbours as one of their offices is just down the road from here •

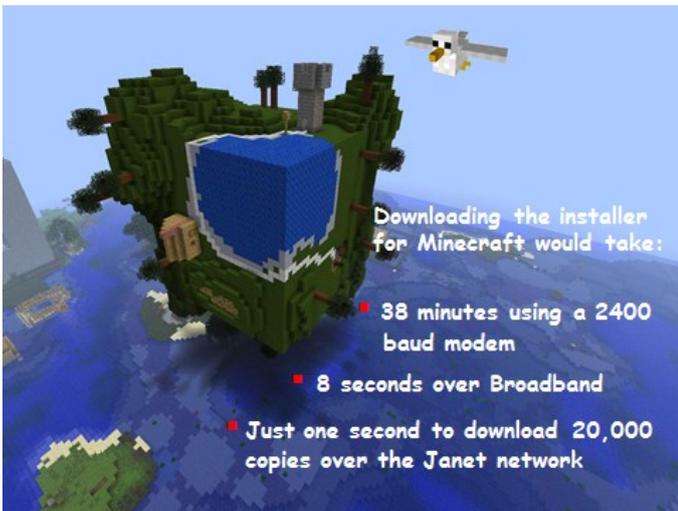


Cable kindly donated by  sse  and janet

- Until the 1970s it was illegal to interfere with British Telecom's phone lines • But an **acoustic coupler** allowed one computer to connect to another using a MODEM and conventional telephone handset which was placed across the two cups • It was very slow at just 300 baud (bits per second) • If you tried to phone somebody while the unit was in operation you would have heard a quivering, squeaking noise with lots of static •

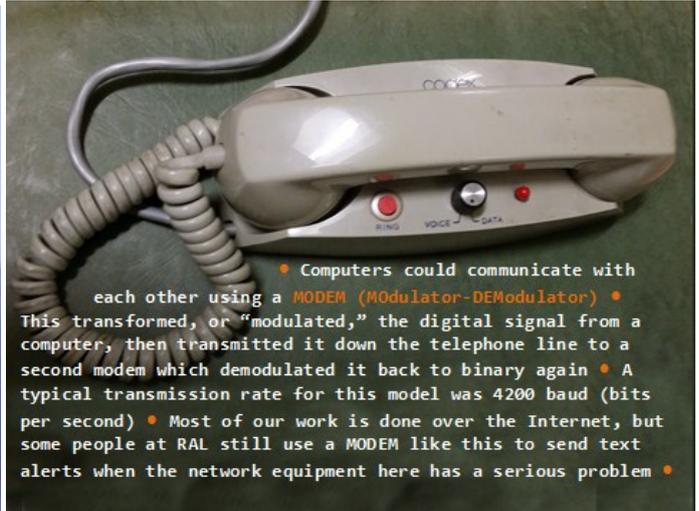


- **Optical fibres** made from transparent glass (silica) or plastic • They are each only slightly thicker than a human hair •

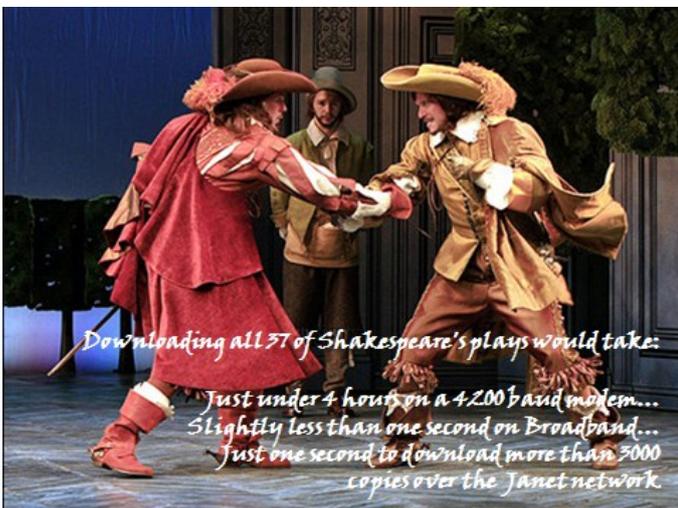


Downloading the installer for Minecraft would take:

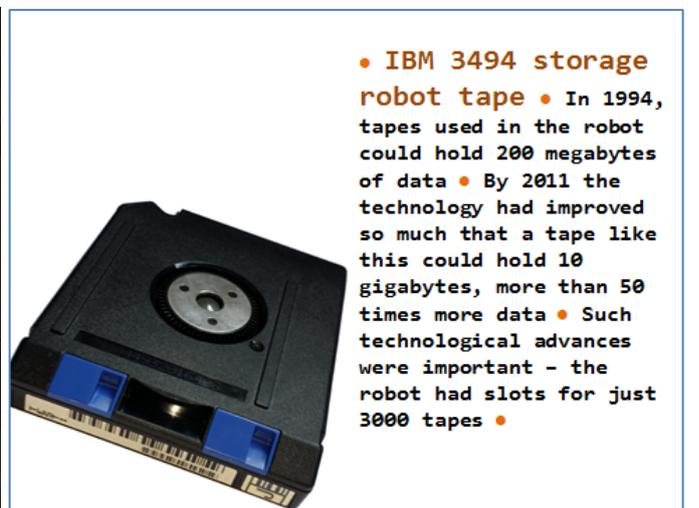
- 38 minutes using a 2400 baud modem
- 8 seconds over Broadband
- Just one second to download 20,000 copies over the Janet network



- Computers could communicate with each other using a **MODEM (MODulator-DEModulator)** • This transformed, or "modulated," the digital signal from a computer, then transmitted it down the telephone line to a second modem which demodulated it back to binary again • A typical transmission rate for this model was 4200 baud (bits per second) • Most of our work is done over the Internet, but some people at RAL still use a MODEM like this to send text alerts when the network equipment here has a serious problem •



Downloading all 37 of Shakespeare's plays would take:  
 Just under 4 hours on a 4200 baud modem...  
 Slightly less than one second on Broadband...  
 Just one second to download more than 3000 copies over the Janet network.



- **IBM 3494 storage robot tape** • In 1994, tapes used in the robot could hold 200 megabytes of data • By 2011 the technology had improved so much that a tape like this could hold 10 gigabytes, more than 50 times more data • Such technological advances were important - the robot had slots for just 3000 tapes •

- If a USB stick took a selfie it could store nearly 3000 copies of the photo •
- If a magnetic tape took a selfie it could store seven photos •
- If an Atlas disc took a selfie it could store just two photos\* •



\*This is silly of course - magnetic media can't take selfies!

