

The 1000 billionth binary digit of PI is '1' !

After about one month of computation on more than twenty high-end workstations and PCs, we can announce that:

The 1000 billionth (10^{12}) binary digits of PI are

```
1000 0111 1111 0111 0010 1011 0001 1101
1100 1001 0111 1000 0110 1001 0001 0100
1011 0001 0101 1011 0001 0110 1111 1110
1001 0010 0001 1000 1011 0000 0100 0010
1010 0011 1101 0100 0001 0000
```

[In the more compact hexadecimal notation, we obtain
87F72B1DC9786914B15B16FE9218B042A3D410].

The computation was carried out by using the algorithm described in On The Rapid Computation of Various Polylogarithmic Constants by David Bailey, Peter Borwein, and Simon Plouffe. However, the slightly faster Bellard's binary formula was used.

A generic parallel computation program was developed to handle the communications between the server and the clients. It has been designed to handle huge computations with small communications between the server and the clients with a high reliability.

The first computation took 220 days of CPU time, and 12 days of real time. A second computation was done to verify the first. We computed the digits starting at offset $(10^{12})-9$ using the same formula. Since the intermediate results are not correlated, this is a good verification method. The second computation took 180 days of CPU time because of a better optimized code. The computer used were mainly UltraSparc workstations. We used some Pentium PCs, DEC Alpha 200 and 3000, and SGI10000 computers too.

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Sept 22 1997, Fabrice Bellard (bellard@email.enst.fr).