Proposal for completing the IEEE 754 functionality in RISC-V.

Proposed instruction format and mnemonics by Trond Endrestøl (Trond.Endrestol@ximalas.info). The RISC-V Foundation is to determine the letter(s) assigned to this extension/these extensions.

The aim is to provide a fixed set of opcodes for these floating point operations and possibly eliminate software emulation of said operations. The total number of instructions require two opcode prefixes to make it easier to distinguish between instructions needing one or two source operands.

These are the operations this extension/these extensions will provide.

- e^x
- 2^x
- 10^x
- $(e^x) - 1$
- $(2^x) - 1$
- $(10^x) - 1$
- $\ln x$
- $\log_2 x$
- $\log_{10} x$
- $\ln(1 + x)$
- $\log_2(1 + x)$
- $\log_{10}(1 + x)$
- $\sqrt{x^2 + y^2}$
- $(1 + x)^n$
- $x^{\frac{1}{n}}$
- x^n
- x^y
- $\sin x$
- $\cos x$
- $\tan x$
- $\arcsin x$
- $\arccos x$
- $\arctan x$
- $\arctan 2(y, x)$
- $\sin \pi x$
- $\cos \pi x$
- $\frac{\arctan x}{\pi}$
- $\frac{\arctan 2(y,x)}{\pi}$
- $\sinh x$
- $\cosh x$
- $\tanh x$
- $\text{arcsinh } x$
- $\text{arccosh } x$
- $\text{arctanh } x$

See https://en.wikipedia.org/wiki/IEEE_754#Recommended_operations for further description.

31 27	26 25	24 20	19 15	14 12	11 7	6 0
funct5	fmt	rs2	rs1	rm	rd	opcode
5	2	5	5	3	5	7
FEPOWX	S/D/Q	N/A	X	RM	dest	OP-FPX1
F2POWX	S/D/Q	N/A	X	RM	dest	OP-FPX1
F10POWX	S/D/Q	N/A	X	RM	dest	OP-FPX1
FEPOWXM1	S/D/Q	N/A	X	RM	dest	OP-FPX1
F2POWXM1	S/D/Q	N/A	X	RM	dest	OP-FPX1
F10POWXM1	S/D/Q	N/A	X	RM	dest	OP-FPX1
FLN	S/D/Q	N/A	X	RM	dest	OP-FPX1
FLOG2	S/D/Q	N/A	X	RM	dest	OP-FPX1
FLOG10	S/D/Q	N/A	X	RM	dest	OP-FPX1
FLN1PX	S/D/Q	N/A	X	RM	dest	OP-FPX1
FLOG21PX	S/D/Q	N/A	X	RM	dest	OP-FPX1
FLOG101PX	S/D/Q	N/A	X	RM	dest	OP-FPX1
FSIN	S/D/Q	N/A	X	RM	dest	OP-FPX1
FCOS	S/D/Q	N/A	X	RM	dest	OP-FPX1
FTAN	S/D/Q	N/A	X	RM	dest	OP-FPX1
FASIN	S/D/Q	N/A	X	RM	dest	OP-FPX1
FACOS	S/D/Q	N/A	X	RM	dest	OP-FPX1
FATAN	S/D/Q	N/A	X	RM	dest	OP-FPX1
FSINPI	S/D/Q	N/A	X	RM	dest	OP-FPX1
FCOSPI	S/D/Q	N/A	X	RM	dest	OP-FPX1
FATANPI	S/D/Q	N/A	X	RM	dest	OP-FPX1
FSINH	S/D/Q	N/A	X	RM	dest	OP-FPX1
FCOSH	S/D/Q	N/A	X	RM	dest	OP-FPX1
FTANH	S/D/Q	N/A	X	RM	dest	OP-FPX1
FASINH	S/D/Q	N/A	X	RM	dest	OP-FPX1
FACOSH	S/D/Q	N/A	X	RM	dest	OP-FPX1
FATANH	S/D/Q	N/A	X	RM	dest	OP-FPX1
FHYPOT	S/D/Q	Y	X	RM	dest	OP-FPX2
F1PXPOWN	S/D/Q	N	X	RM	dest	OP-FPX2
FXPOWINVN	S/D/Q	N	X	RM	dest	OP-FPX2
FXPOWN	S/D/Q	N	X	RM	dest	OP-FPX2
FXPOWY	S/D/Q	Y	X	RM	dest	OP-FPX2
FATAN2	S/D/Q	Y	X	RM	dest	OP-FPX2
FATAN2PI	S/D/Q	Y	X	RM	dest	OP-FPX2

Proposed encoding of funct5 and opcode.

FEPOWX	00000	OP-FPX1
F2POWX	00001	OP-FPX1
F10POWX	00010	OP-FPX1
FEPOWXM1	00011	OP-FPX1
F2POWXM1	00100	OP-FPX1
F10POWXM1	00101	OP-FPX1
FLN	00110	OP-FPX1
FLOG2	00111	OP-FPX1
FLOG10	01000	OP-FPX1
FLN1PX	01001	OP-FPX1
FLOG21PX	01010	OP-FPX1
FLOG101PX	01011	OP-FPX1
FSIN	01100	OP-FPX1
FCOS	01101	OP-FPX1
FTAN	01110	OP-FPX1
FASIN	01111	OP-FPX1
FACOS	10000	OP-FPX1
FATAN	10001	OP-FPX1
FSINPI	10010	OP-FPX1
FCOSPI	10011	OP-FPX1
FATANPI	10100	OP-FPX1
FSINH	10101	OP-FPX1
FCOSH	10110	OP-FPX1
FTANH	10111	OP-FPX1
FASINH	11000	OP-FPX1
FACOSH	11001	OP-FPX1
FATANH	11010	OP-FPX1
FHYPOT	00000	OP-FPX2
F1PXPOWN	00001	OP-FPX2
FXPOWINVN	00010	OP-FPX2
FXPOWN	00011	OP-FPX2
FXPOWY	00100	OP-FPX2
FATAN2	00101	OP-FPX2
FATAN2PI	00110	OP-FPX2

OP-FPX1 and OP-FPX2 to be named and assigned their values by the RISC-V Foundation.