

# Haverford Educational Research Architecture (HERA), Version 2 Upgrade Notes

## 1 Version 2.2.2 to Version 2.2.3

Fixed minor inconsistencies in HERA documentation and HERA-C, regarding the parameters for the NOT and NEG pseudo-ops — now both have distinct source and target registers.

## 2 Version 2.2.1 to Version 2.2.2

Various minor corrections/clarifications of inconsistencies (generally fixed in “obvious” ways):

- Fixed an inconsistency in the description of the binary instructions for flag set/clear, and corrected the totally wrong examples that had added to the confusion.
- Fixed incorrect examples of INC/DEC op. codes.
- Added Op. Codes column to Quick Guide.

## 3 Version 2.2 to Version 2.2.1

Corrected the definition of BUG and BULE to have  $\bar{C}$  rather than  $C$  (also cited Mano’s definition for branch instructions).

## 4 Version 2.1 to Version 2.2

No binary operations were changed, but some flag definitions were changed to make a few things better:

- SETLO and SETHI no longer affect any flags. This allows assemblers to accept register-mode branch instructions with labels and use the temporary register (e.g. BRZ(label) becomes SET(tmp, label); BRZ(tmp)), which would not have worked in version 2.1 because the SETLO and SETHI would have killed the values of some flags.
- 8-bit shifts now shift in eight 0’s — the other thing was goofy.

Also clarified the TIGER\_STRING cannot contain control characters.

## 5 Version 2.0 to Version 2.1

Several op codes have changed to make the following organizational changes:

- XOR is now a 3-address operation, like the other arithmetic operations.
- NOT is now a pseudo-op that sets  $R_t$  and uses XOR

## 6 Version 2.0 Alpha 1 to Version 2.0 Alpha 2

- Clarified that SETLO sign-extends a signed quantity

- Clarified that INC/DEC assembly language requires the value to be added/subtracted
- Retracted the unfortunate attempt to change the order of many operands

## 7 Version 1 to Version 2

Many, many elements of the HERA machine language have changed since Version 1. However, the assembly language is largely compatible with that of Version 1, except for the following

- For version 2.0 alpha 2 and later, most of the operands are in the same order, though there may be some exceptions (the 2.0 alpha 1 made changes to the order that were quickly retracted).
- most bitwise operations (except XOR) are now three-address rather than two-address (XOR is included in V.2.1)
- the bitwise NAND operation has been dropped
- logical shifts must be either 1-bit or 8-bit shifts (though now arithmetic shifts and rotates are supported)
- The LOAD operation sets the *s* and *z* flags; shift and bitwise operations no longer set *c* and *v*.
- The branch operations and pseudo-ops have changed significantly
- The ZERO pseudo-operation is no longer supported (as far as I know it was never used).
- The unconditional branch pseudo-op JUMP has been omitted (due to the new BR pseudo-op)
- The CALL and branch pseudo-operations no longer need a temporary register – they use  $R_{13}$  automatically.