The **IEEE-754 Binary-32 Floating-Point Converter** is a web application that allows users to convert between decimal and binary representations, including handling special cases like NaN (Not a Number). The application provides detailed steps of the conversion process and displays the final result in both binary and hexadecimal formats.

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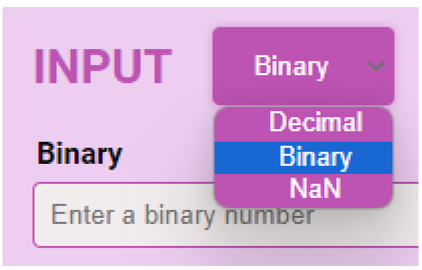
How to Use the IEEE-754 Binary-32 Floating-Point Converter

Google Drive link to Video Demonstration

1. **Select Input Type**



Choose the type of input you want to convert.

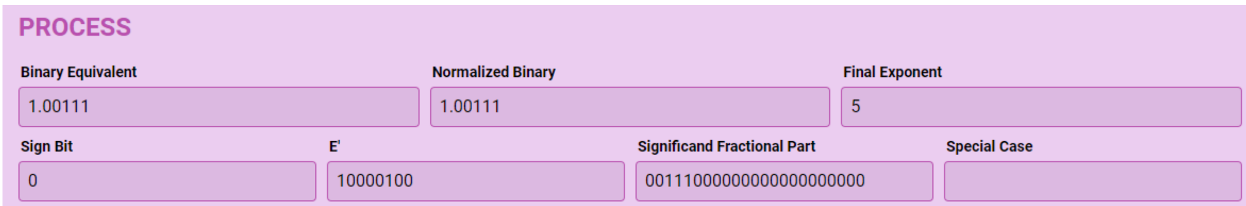
- You can pick between **Decimal** (base-10 exponent), **Binary** (base-2 exponent), or **NaN** from the dropdown menu.
- Depending on your selection, the input fields and labels will adjust accordingly.

2. **Enter Mantissa and Exponent**

- **Mantissa Input**
  - **Decimal**: Enter a decimal number (e.g., 15.75)
  - **Binary**: Enter a binary number (e.g., 101.01).
  - **NaN**: Enter qnan or snan.
- **Exponent Input**
  - For **Decimal**/**Binary**: Enter the exponent (e.g., **5** for 15.75x10^5 or **2** for 101.01x2^2).
- Both positive (**+**) and negative (**-**) symbols are allowed for the Mantissa and Exponent input.

3. Click Compute

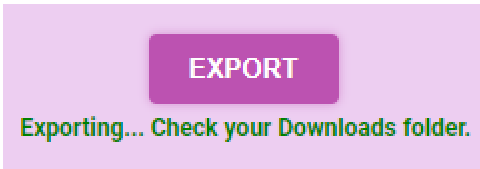
- ❖ After entering the values, press the 'Compute' button to perform the conversion.
- ❖ The application will validate the inputs and perform the conversion.



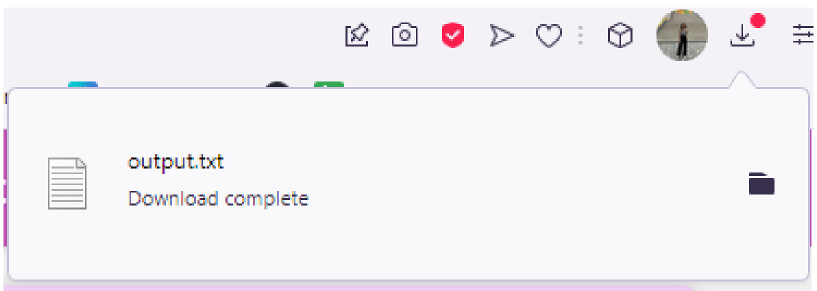
- ❖ The results will be displayed in the process section, showing:
  - ➢ Binary Equivalent
  - ➢ Normalized Binary
  - ➢ Final Exponent
  - ➢ Sign Bit
  - ➢ E'
  - ➢ Significand Fractional Part
  - ➢ Special Case (if any)

4. **Export Results**

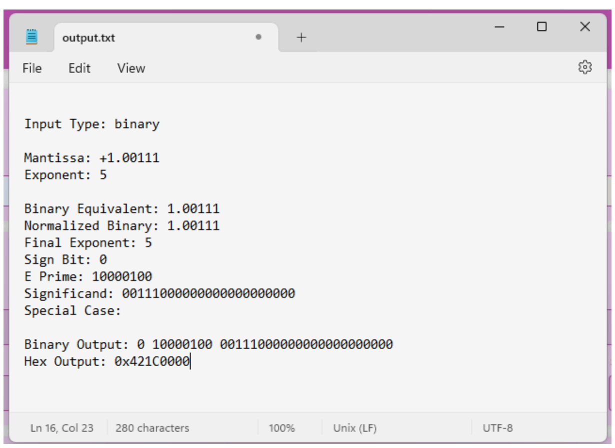
- ❖ If you wish to save the results, click the 'Export' button.



- ❖ If the inputs are valid, a notification will appear indicating that the file is being exported.

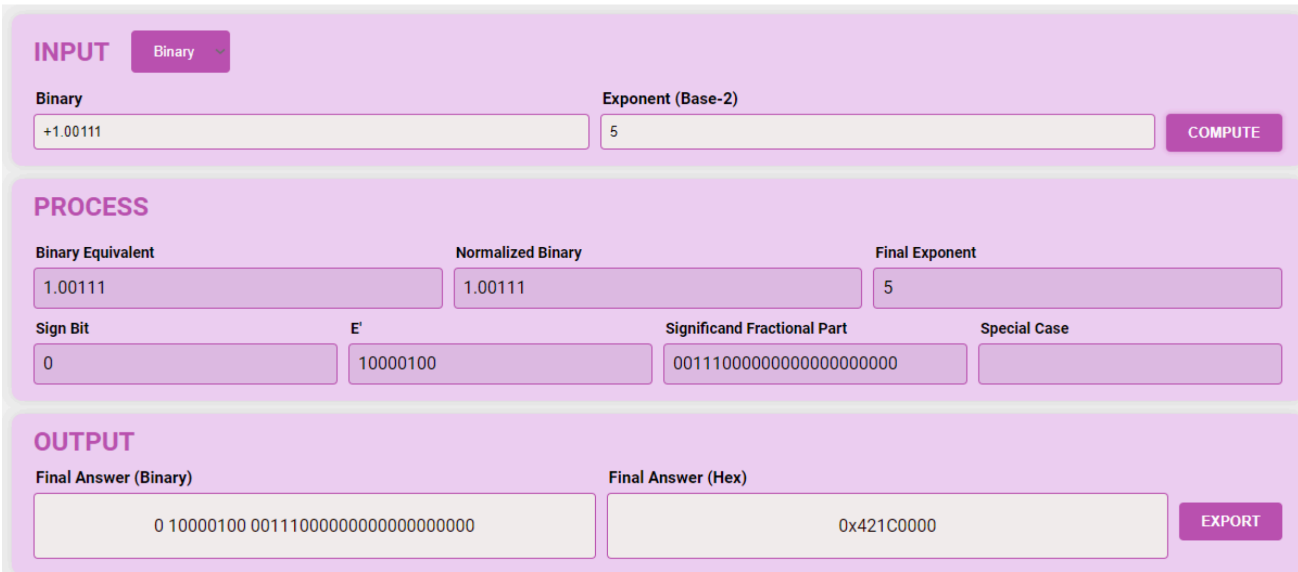


- ❖ The result will be saved as a text file on your local machine.

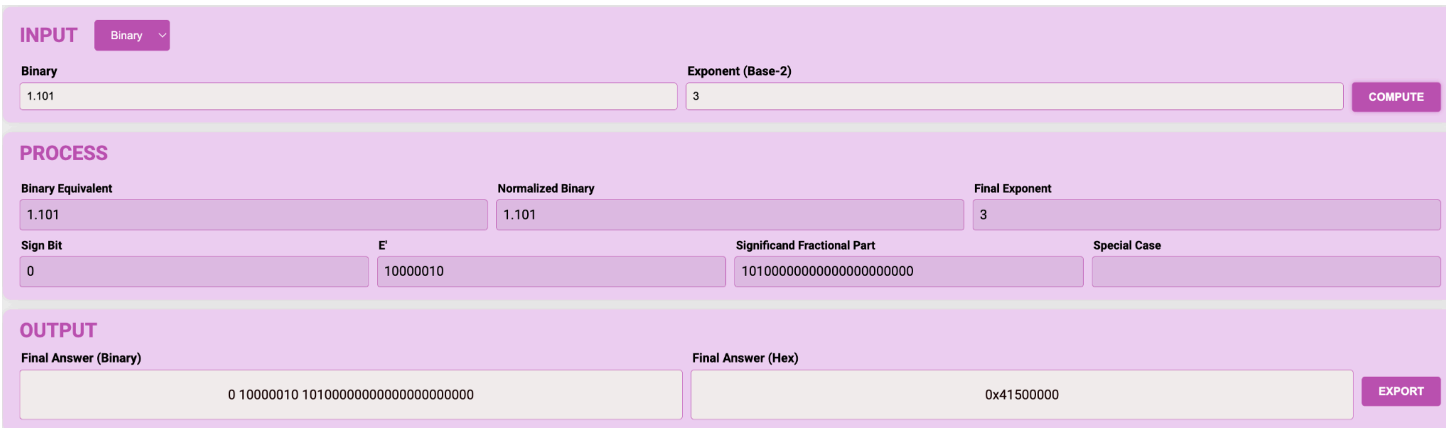


- ❖ The **text file** will include the input values, conversion process, and the binary and hexadecimal outputs.

Test Cases and Results

Case 1: **Normal** with **Positive Binary** Input (+ symbol **included**)	
Input: +1.00111	**Exponent: 5**
	

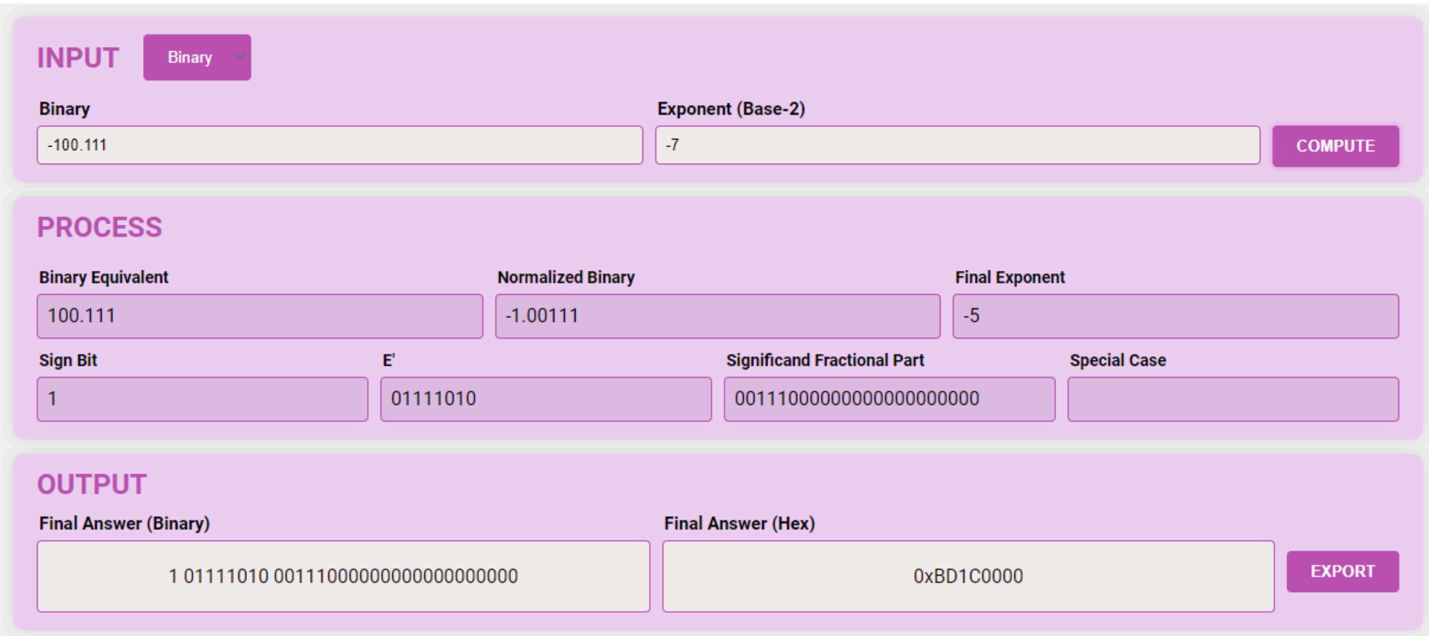
Case 2: **Normal** with **Positive Binary** Input (+ symbol **excluded**)	
Input: 1.101	**Exponent: 3**



Test case #1 and #2 shows that the program can accept a positive binary with and without a positive symbol included as a valid input. It also shows that the program can process the binary and exponent (base-2) input to provide the appropriate Binary Equivalent, Normalized Binary, Final Exponent, Sign Bit, E prime, and Significand Fractional Part. The blank special case indicates that the sample test case is normal and does not belong to any special cases in the conversion of binary 32 floating-point. The program also outputs the final answer in binary and in hex successfully.

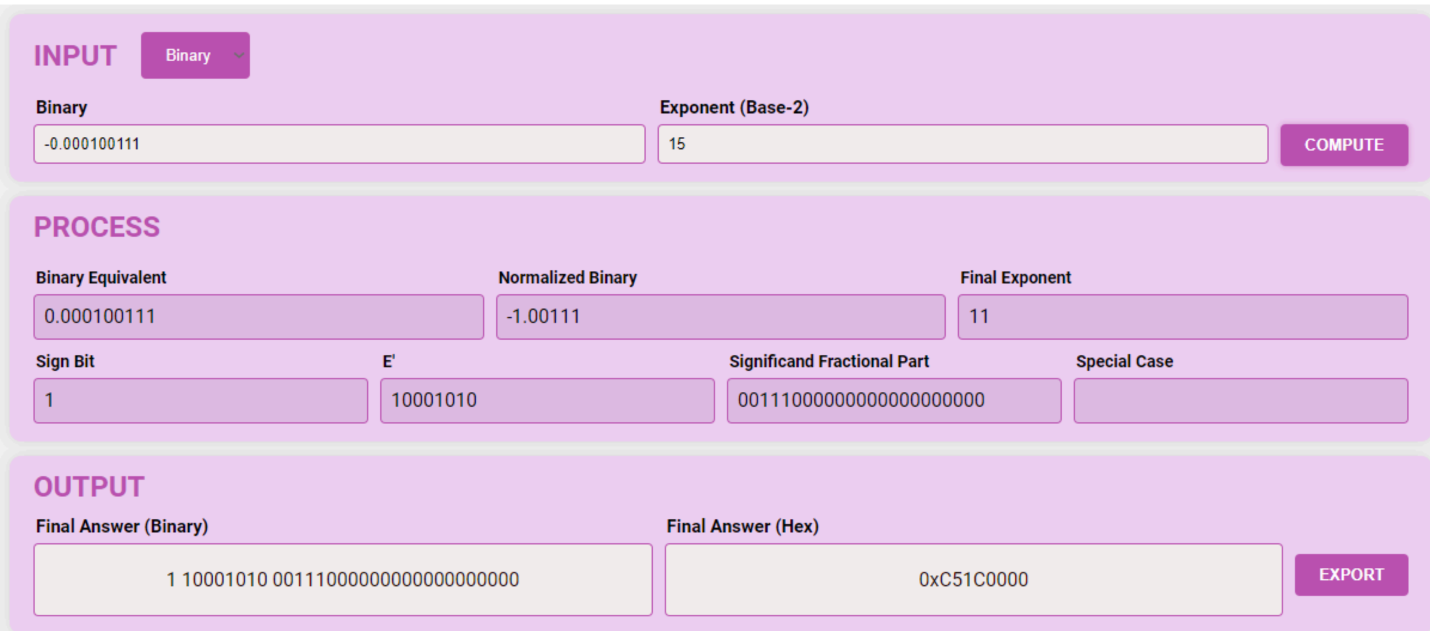
The following test cases will also show a formatted final answer in binary, following the format [sign bit] [E'] [Significand]; and a formatted final answer in hex following the format [0x][final answer in hex].

Case 3: **Normal** with **Negative Binary** Input	
Input: -100.111	**Exponent: -7**



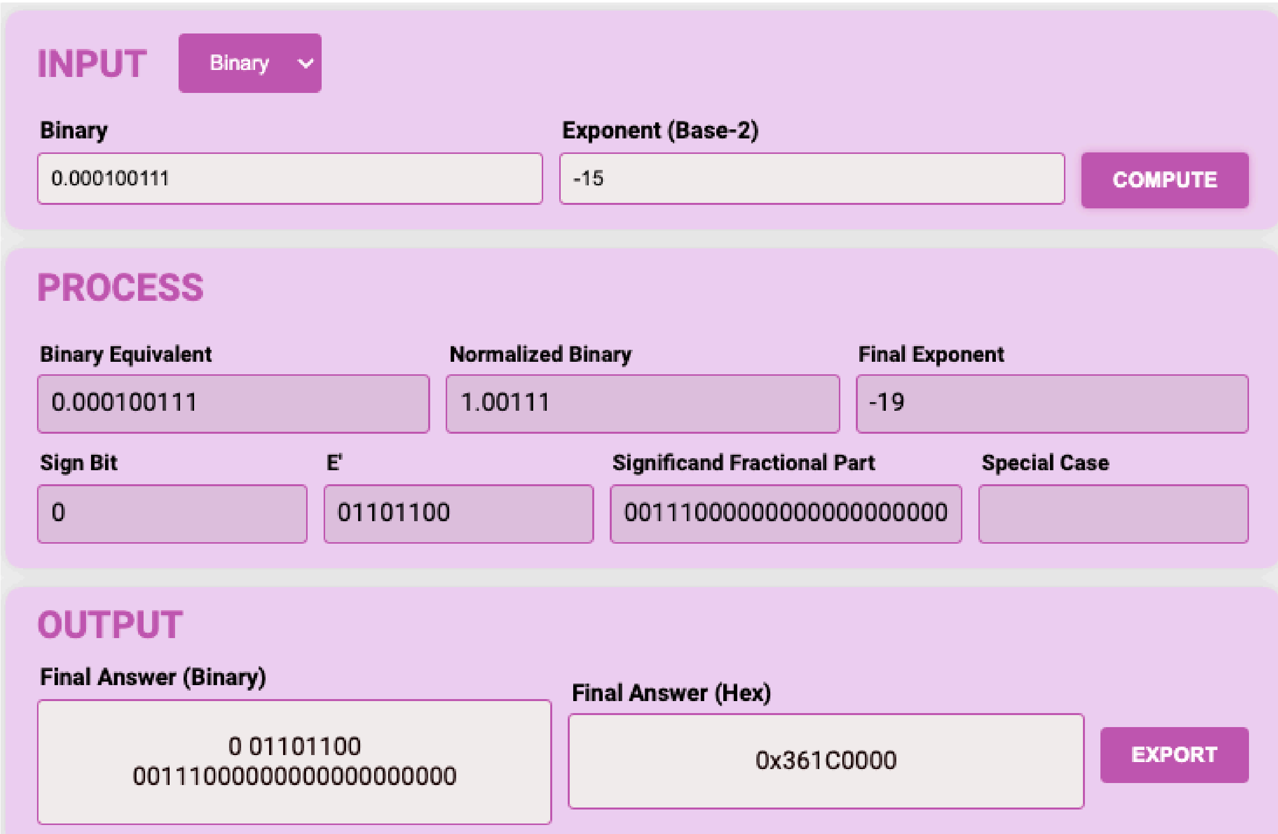
This test case shows that the program can accept a negative binary with a negative symbol, and a negative exponent included as a valid input. The blank special case indicates that the sample test case is normal and does not belong to any special cases in the conversion of binary 32 floating-point.

Case 4: **Normal** with **Negative Binary** and **Positive Exponent** Inputs	
Input: -0.000100111	**Exponent: 15**



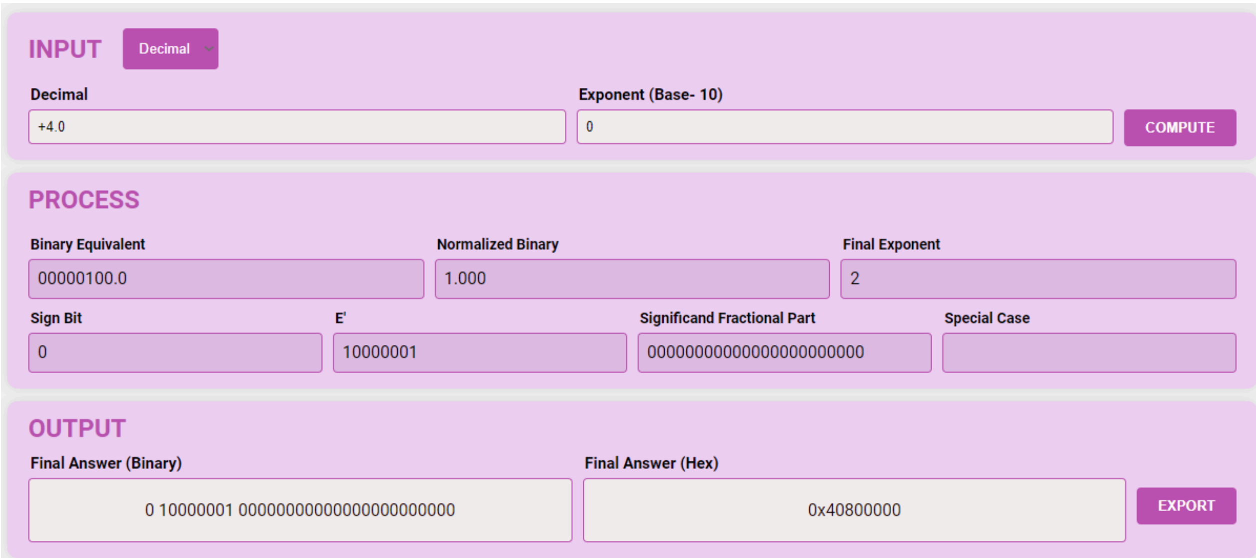
This test case shows that the program can accept a negative binary with a negative symbol, and a positive exponent included as a valid input. The blank special case indicates that the sample test case is normal and does not belong to any special cases in the conversion of binary 32 floating-point.

Case 5: **Normal** with **Positive Binary** and **Negative Exponent** Inputs	
Input: 0.000100111	**Exponent: -15**

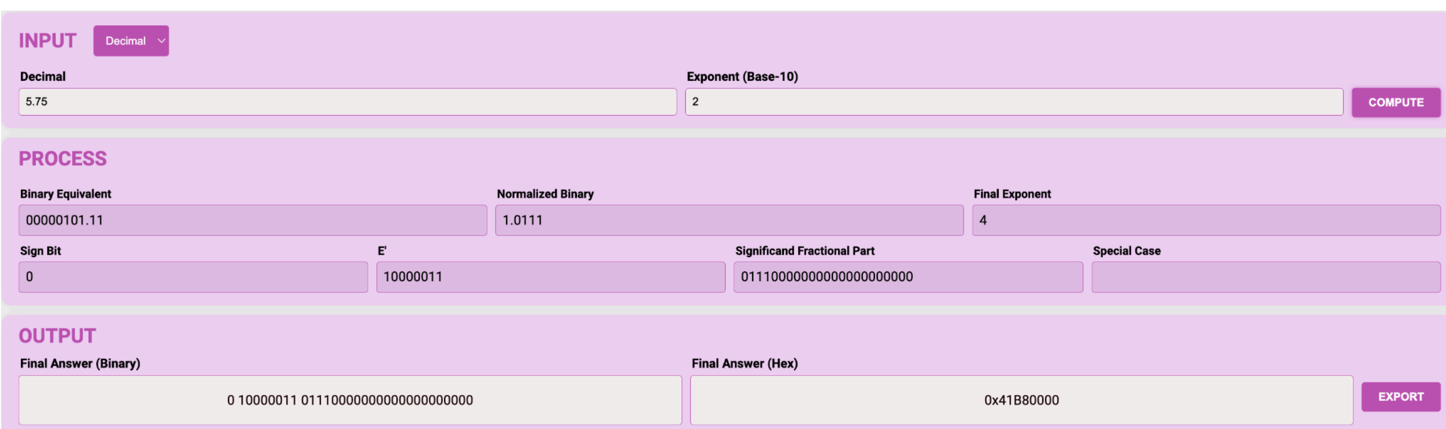


This test case shows that the program can accept a positive binary without a positive symbol, and a negative exponent included as a valid input. The blank special case indicates that the sample test case is normal and does not belong to any special cases in the conversion of binary 32 floating-point.

Case 6: **Normal** with **Positive Decimal** Input (+ symbol **included**)	
Input: +4.0	**Exponent: 0**

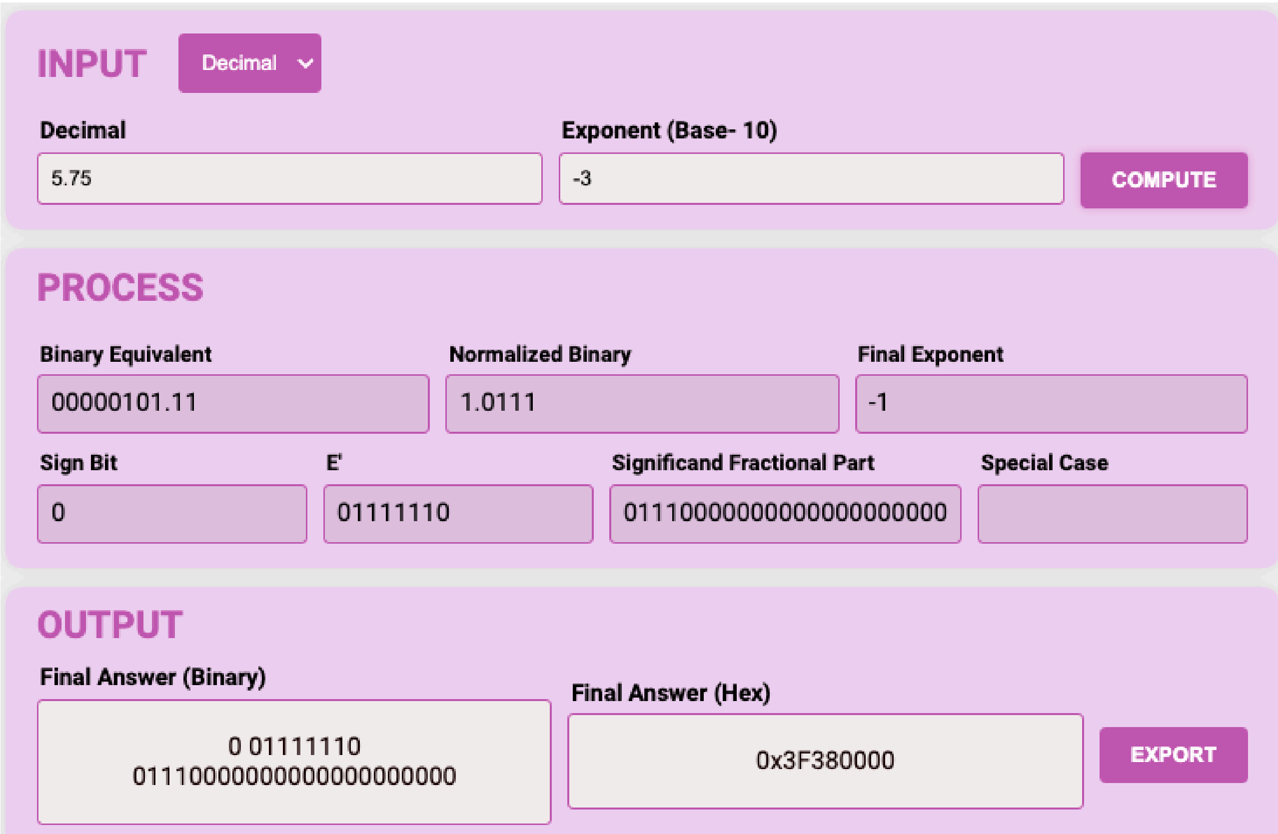


Case 7: **Normal** with **Positive Decimal** Input (+ symbol **excluded**)	
Input: 5.75	**Exponent: 2**



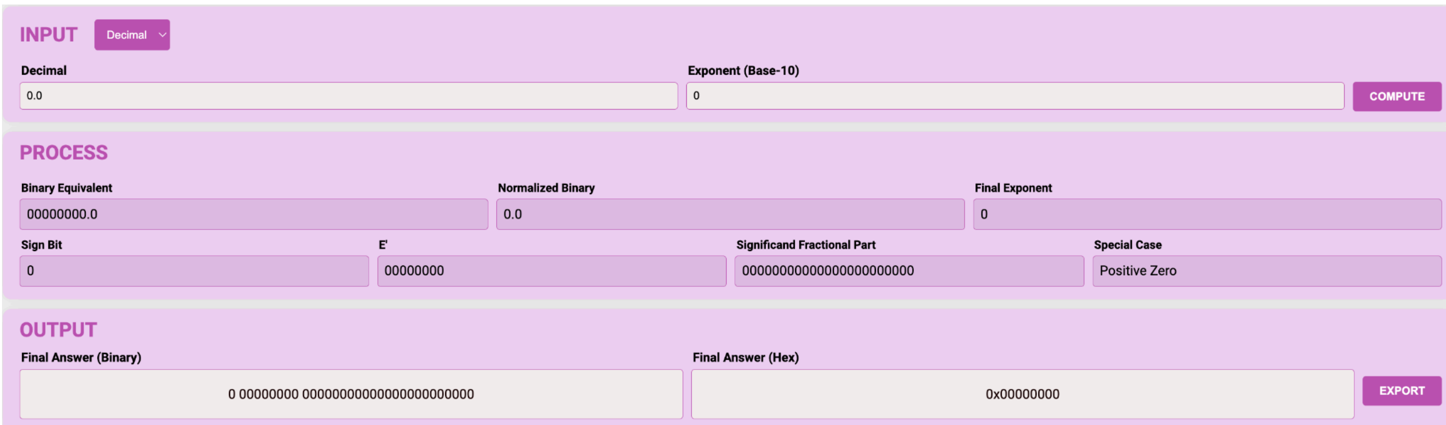
Test case #6 and #7 shows that the program can accept a positive decimal with and without a positive symbol included as a valid input. The blank special case indicates that the sample test case is normal and does not belong to any special cases in the conversion of binary 32 floating-point.

Case 8: **Normal** with **Negative Decimal** Input	
Input: 5.75	**Exponent:** -3

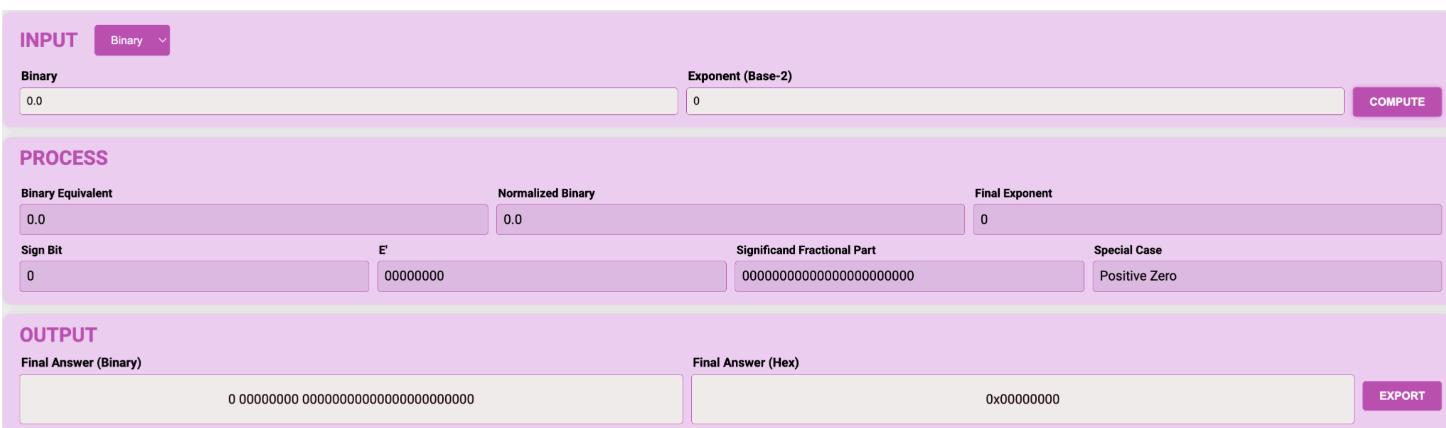


This test case shows that the program can accept a negative decimal and a negative exponent (base-10) included as a valid input. The blank special case indicates that the sample test case is normal and does not belong to any special cases in the conversion of binary 32 floating-point.

Case 9: **Normal** with **Positive Zero Decimal** Input	
Input: 0.0	**Exponent: 0**



Case 10: **Normal** with **Positive Zero Binary** Input	
Input: 0.0	**Exponent: 0**



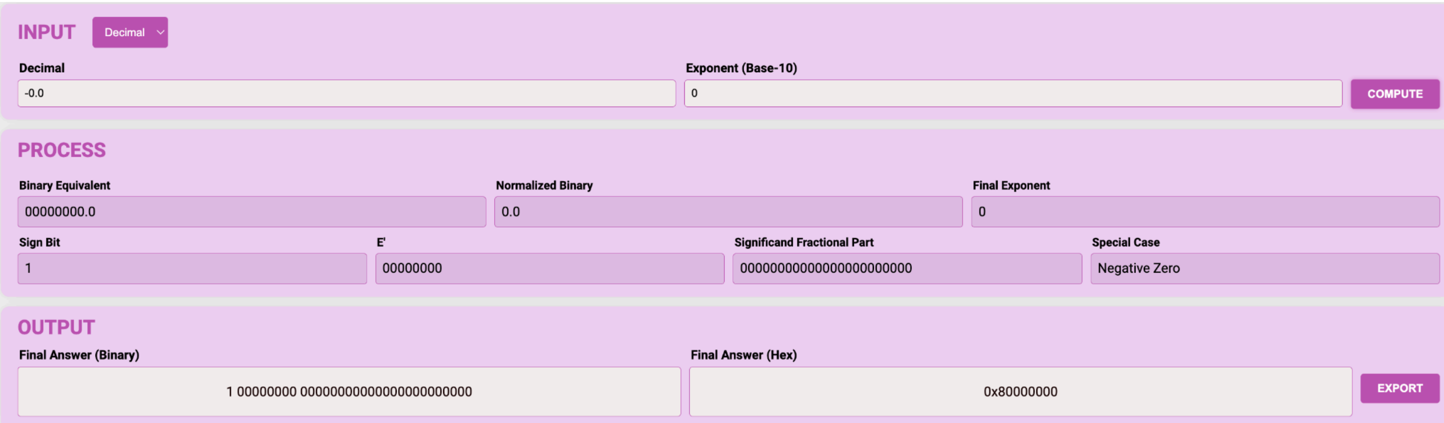
Test case #9, #10, #11, and #12 shows that the program can accept positive zero binary and decimal, and negative zero binary and decimal as a valid input. The program then identifies the test case as an infinity special case and provides the equivalent final answer in binary and in hex.

The following test cases for zero special case will be having an output (for the process) of the following:

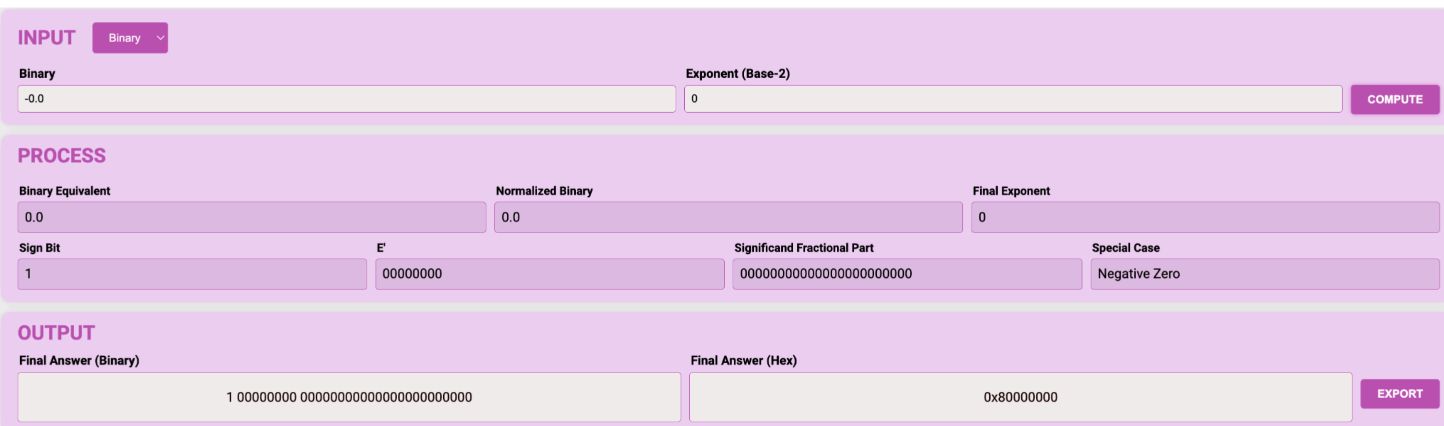
- Sign bit: 0
- E': 0000 0000

  Significand: 000 0000 0000 0000 0000 0000

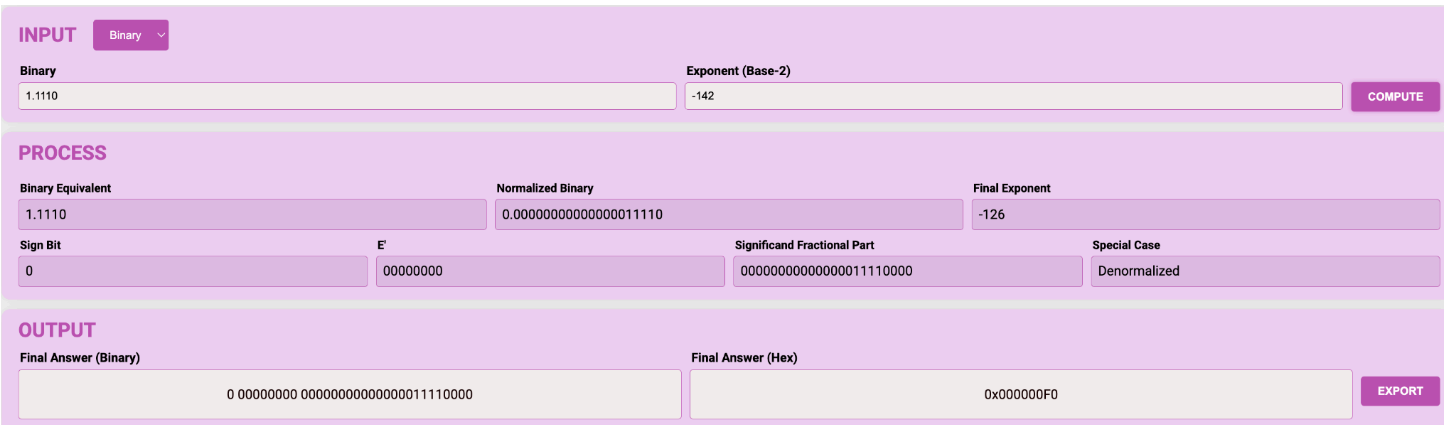
Case 11: **Normal** with **Negative Zero Decimal** Input	
Input: 0.0	**Exponent: 0**



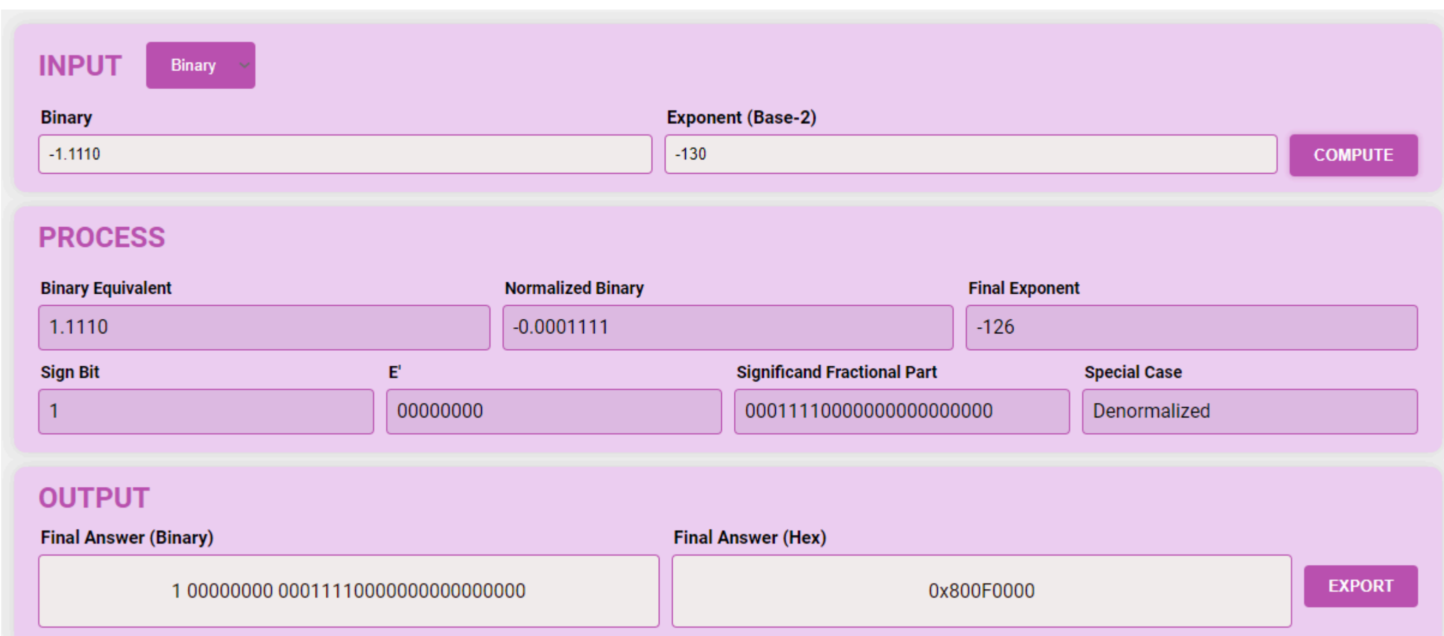
Case 12: **Normal** with **Negative Zero Binary** Input	
Input: 0.0	**Exponent: 0**



Case 13: **Denormalized** with **Positive Binary** Input	
Input: 1.1110	**Exponent: -142**

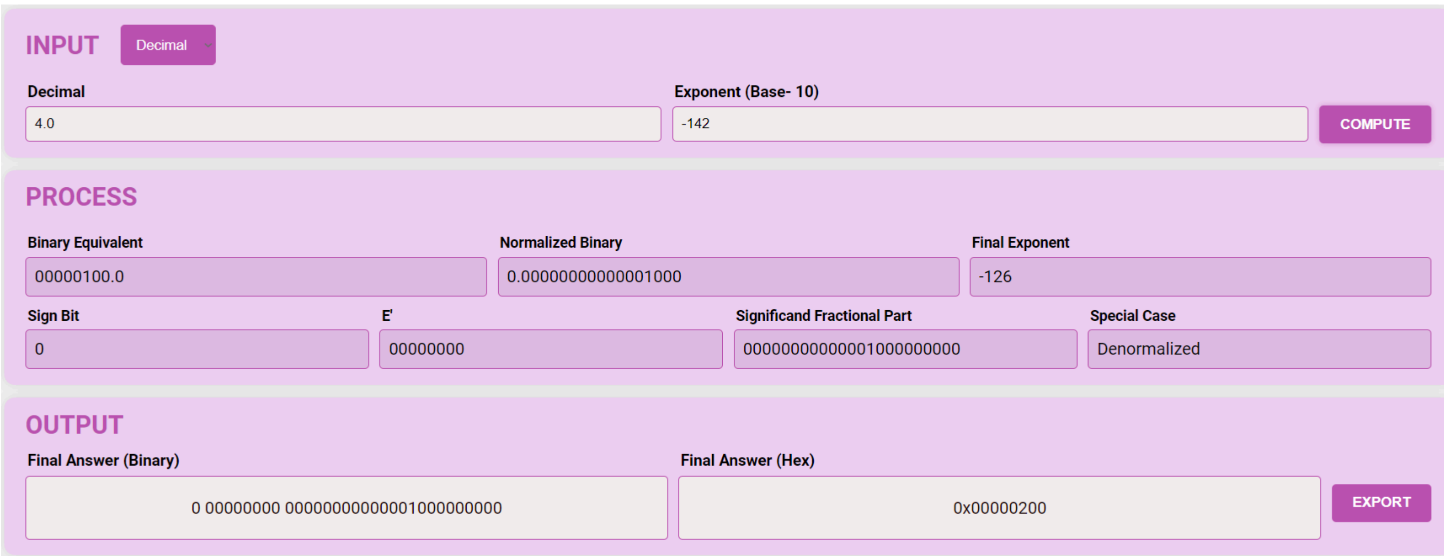


Case 14: **Denormalized** with **Negative Binary** Input	
Input: -1.1110	**Exponent: -130**

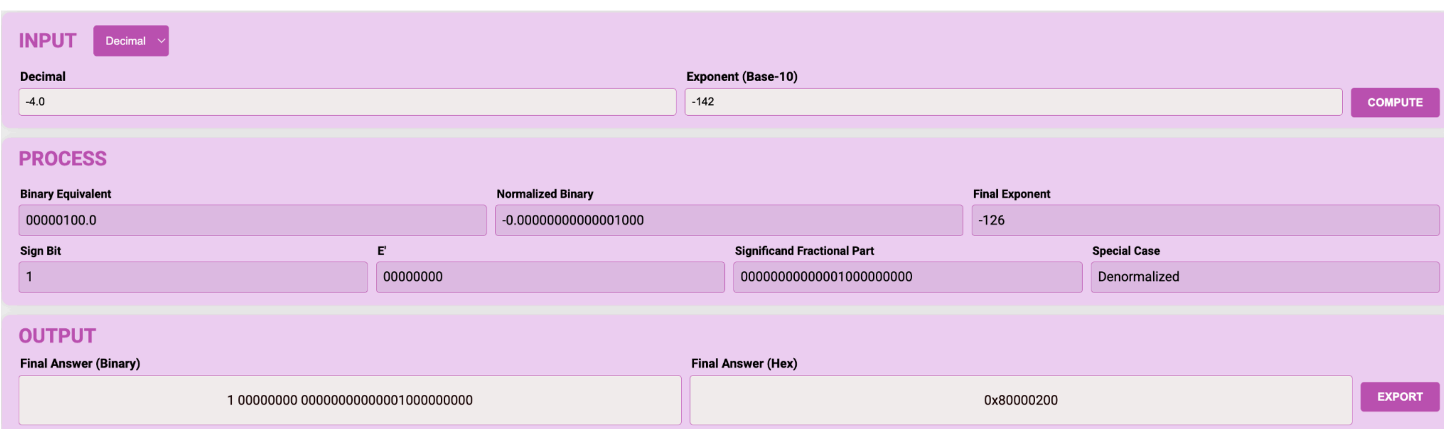


Test cases #13 and #14 shows that the program can accept both positive and negative binary as a valid input. The program then identifies the test case as a denormalized special case and provides the equivalent normalized binary value.

Case 15: **Denormalized** with **Positive Decimal** Input	
Input: 4.0	**Exponent: 142**

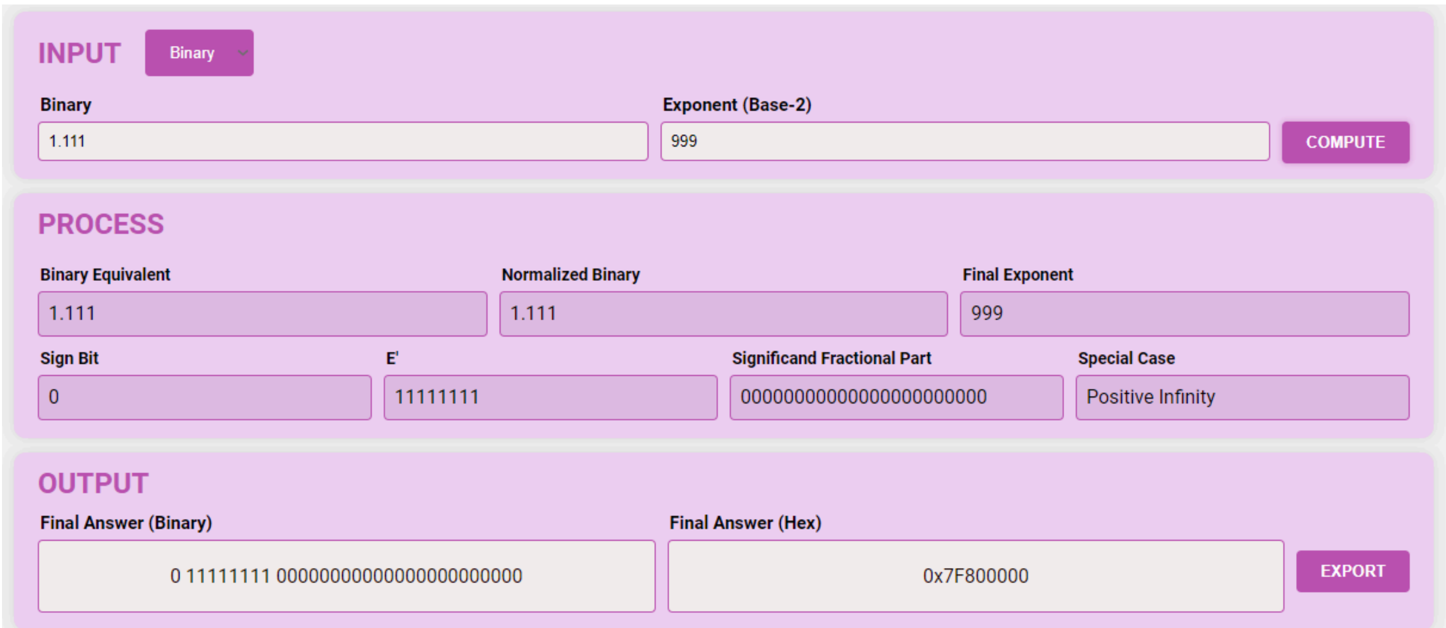


Case 16: **Denormalized** with **Negative Decimal** Input	
Input: -4.0	**Exponent: -142**

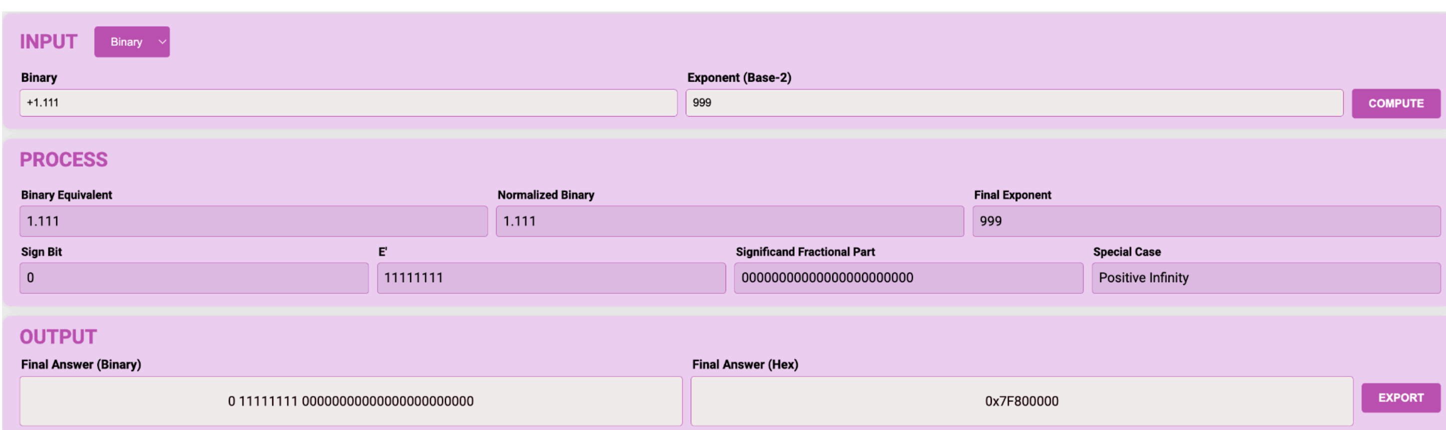


Test cases #15 and #16 shows that the program can accept both positive and negative decimal as a valid input. The program then identifies the test case as a denormalized special case and provides the equivalent normalized binary value.

Case 17: **Infinity** with **Positive Binary** Input (+ symbol excluded)	
Input: 1.111	**Exponent:** 999

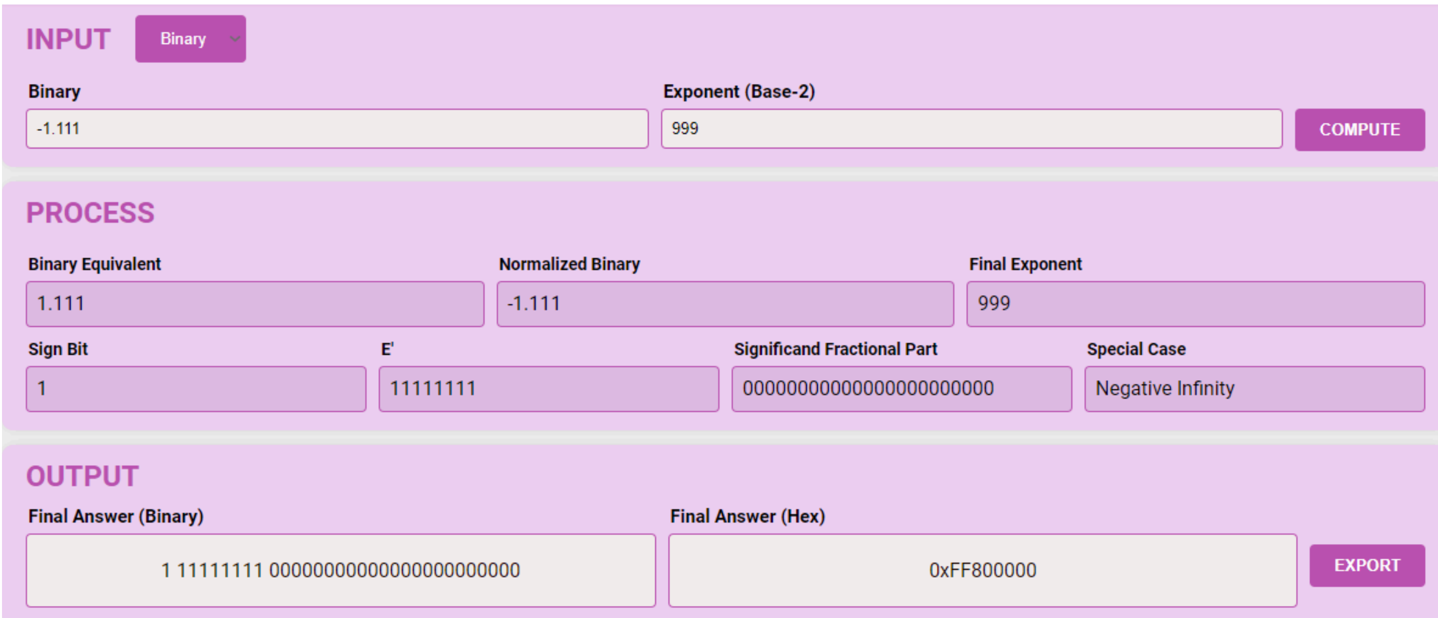


Case 18: **Infinity** with **Positive Binary** Input (+ symbol included)	
Input: +1.111	**Exponent:** 999



Test case #17 and #18 shows that the program can accept a positive binary with and without a positive symbol as a valid input. The program then identifies the test case as an infinity special case and provides the equivalent final answer in binary and in hex.

Case 19: **Infinity** with **Negative Binary** Input	
Input: -1.111	**Exponent: 999**

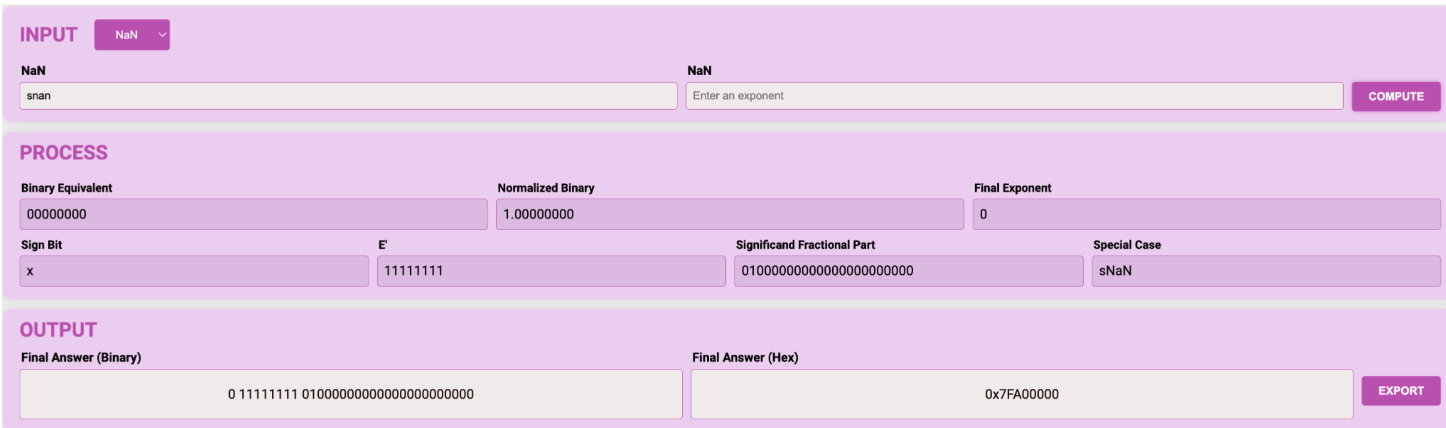


This test case shows that the program can accept a negative binary as a valid input. The program then identifies the test case as an infinity special case and provides the equivalent final answer in binary and in hex.

The test cases for infinity special case will be having an output (for the process) of the following:

- Sign bit: 0 for positive infinity, 1 for negative infinity
- E’: 1111 1111
- Significand: 000 0000 0000 0000 0000 0000

Case 20: **Signaling NaN** input:	
Input: snan	**Exponent: N/A**



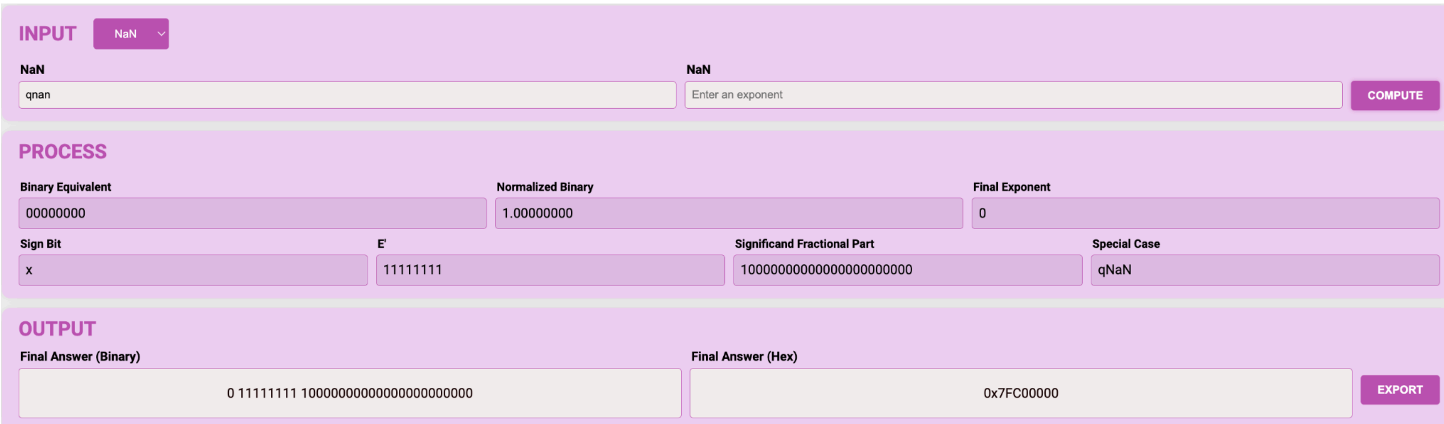
The following NaN test cases show that the program can accept a NaN as a valid input. The program then identifies the test case as a NaN special case and provides the equivalent final answer in binary and in hex.

The program accepts 2 inputs for NaN special cases being snan (signaling nan) and qnan (quiet nan) respectively.

The following test cases for NaN special case will be having an output (for the process) of the following:

- Sign bit: x (don't care)
- E': 1111 1111
- Significand: 01x xxxx xxxx xxxx xxxx xxxx (sNaN), 1xx xxxx xxxx xxxx xxxx xxxx (qNaN)

Case 21: **Quiet NaN** input:	
Input: snan	**Exponent: N/A**



Learnings and Conclusion:

In this simulation project, the group was able to take a look back into the process converting IEEE-754 binary floating point for single precision and implement this learning into a web-based converter through the use of basic html and css for the front end, and javascript for the backend.

In the process of creating the web-based converter, the group was able to disseminate the various normal and special cases among each other, sharpening each member's logic and implementation of their learnings from IEEE-754 binary floating point for single precision. Each normal case was handled independently through dedicated functions and logic such as the creation of utility/helper funtions such as integerToBinary, fractionalToBinary, and convertDecimalToBinary to be used by other functions in the program. On the other hand, due to the nature of special cases being set and repetitive, the group was able to deduce that the best course of action in this program was to handle the special cases by bruteforce, having each input be first checked by each special case function. In the NaN special case in particular, the group made the program to only accept "snan" and "qnan" as inputs to show the program's ability to process the appropriate outputs as advised by the group's professor. In addition, the group was also able to create a debugger into the program to be used in the console through the function "trialQuickPrint" to be able to trace each algorithm and keep check with the output.

This program was able to encapsulate the processes and cases of IEEE-754 binary floating point for single precision conversion finishing with a feature to export each final output into a downloadable text file.