Identify various RISC-V instruction type (R, I, S, B, U, J) and exact 32-bit instruction code in the instruction type format for below RISC-V instructions

ADD r6, r2, r1
SUB r7, r1, r2
AND r8, r1, r3
OR r9, r2, r5
XOR r10, r1, r4
SLT r11, r2, r4
ADDI r12, r4, 5
SW r3, r1, 2
SRL r16, r14, r2
BNE r0, r1, 20
BEQ r0, r0, 15
LW r13, r1, 2
SLL r15, r1, r2

RISC-V Instruction Types

- **R-type**: Used for register-register operations.
- **I-type**: Used for immediate operations.
- **S-type**: Used for store instructions.
- **B-type**: Used for branch instructions.
- **U-type**: Used for upper immediate operations.
- **J-type**: Used for jump instructions.

Instruction Breakdown

Each RISC-V instruction is represented in a specific format depending on its type. Let's detail the structure for each instruction type:

R-Type

- **Format**: **funct7[31:25] rs2[24:20] rs1[19:15] funct3[14:12] rd[11:7] opcode[6:0]**
- **Opcode**: 7 bits (0110011 for R-type)
- **funct3**: 3 bits
- **funct7**: 7 bits

I-Type

- **Format**: **imm[31:20] rs1[19:15] funct3[14:12] rd[11:7] opcode[6:0]**
- **Opcode**: 7 bits (0010011 for arithmetic immediate, 0000011 for loads, etc.)
- **funct3**: 3 bits

S-Type

- **Format**: **imm[31:25] rs2[24:20] rs1[19:15] funct3[14:12] imm[11:7] opcode[6:0]**
- **Opcode**: 7 bits (0100011 for stores)
- **funct3**: 3 bits

B-Type

- **Format**: **imm[31] imm[30:25] rs2[24:20] rs1[19:15] funct3[14:12] imm[11:8] imm[7] opcode[6:0]**
- **Opcode**: 7 bits (1100011 for branches)
- **funct3**: 3 bits

Detailed Instruction Analysis and 32-bit Patterns

R-Type Instructions

1. **ADD r6, r2, r1**
    - **Opcode**: 0110011
    - **funct3**: 000
    - **funct7**: 0000000
    - **Binary Code**: **0000000 00001 00010 000 00110 0110011**
    - **Hex**: 0x002102B3
2. **SUB r7, r1, r2**
    - **Opcode**: 0110011
    - **funct3**: 000
    - **funct7**: 0100000
    - **Binary Code**: **0100000 00010 00001 000 00111 0110011**
    - **Hex**: 0x402081B3
3. **AND r8, r1, r3**
    - **Opcode**: 0110011
    - **funct3**: 111
    - **funct7**: 0000000
    - **Binary Code**: **0000000 00011 00001 111 01000 0110011**
    - **Hex**: 0x003101B3

4. **OR r9, r2, r5**
    - **Opcode**: 0110011
    - **funct3**: 110
    - **funct7**: 0000000
    - **Binary Code**: **0000000 00101 00010 110 01001 0110011**
    - **Hex**: 0x005102B3
5. **XOR r10, r1, r4**
    - **Opcode**: 0110011
    - **funct3**: 100
    - **funct7**: 0000000
    - **Binary Code**: **0000000 00100 00001 100 01010 0110011**
    - **Hex**: 0x004101B3
6. **SLT r11, r2, r4**
    - **Opcode**: 0110011
    - **funct3**: 010
    - **funct7**: 0000000
    - **Binary Code**: **0000000 00100 00010 010 01011 0110011**
    - **Hex**: 0x004102B3
7. **SLL r15, r1, r2**
    - **Opcode**: 0110011
    - **funct3**: 001
    - **funct7**: 0000000
    - **Binary Code**: **0000000 00010 00001 001 01111 0110011**
    - **Hex**: 0x00210133
8. **SRL r16, r14, r2**
    - **Opcode**: 0110011
    - **funct3**: 101
    - **funct7**: 0000000
    - **Binary Code**: **0000000 00010 01110 101 10000 0110011**
    - **Hex**: 0x00271333

I-Type Instructions

9. **ADDI r12, r4, 5**
    - **Opcode**: 0010011
    - **funct3**: 000
    - **Immediate**: 5 (000000000101)
    - **Binary Code**: **000000000101 00100 000 01100 0010011**
    - **Hex**: 0x00520293
10. **LW r13, r1, 2**
    - **Opcode**: 0000011
    - **funct3**: 010
    - **Immediate**: 2 (000000000010)
    - **Binary Code**: **000000000010 00001 010 01101 0000011**
    - **Hex**: 0x00210103

S-Type Instructions

11. **SW r3, r1, 2**
    - **Opcode**: 0100011
    - **funct3**: 010
    - **Immediate**: 2 (0000000 00010)
    - **Binary Code**: **0000000 00010 00011 00001 010 00010 0100011**
    - **Hex**: 0x0021A223

B-Type Instructions

12. **BNE r0, r1, 20**
    - **Opcode**: 1100011
    - **funct3**: 001
    - **Immediate**: 20 (000000 00101 0001 0)
    - **Binary Code**: **000000 00001 00001 001 0001 0 1100011**
    - **Hex**: 0x01410863
13. **BEQ r0, r0, 15**
    - **Opcode**: 1100011
    - **funct3**: 000
    - **Immediate**: 15 (00000 0001 1111 0)
    - **Binary Code**: **00000 00000 00000 000 1111 0 1100011**

- **Hex**: 0x00F00063

Summary

Here is the list of instructions and their corresponding 32-bit codes in hexadecimal format:

1. **ADD r6, r2, r1 - 0x002102B3**
2. **SUB r7, r1, r2 - 0x402081B3**
3. **AND r8, r1, r3 - 0x003101B3**
4. **OR r9, r2, r5 - 0x005102B3**
5. **XOR r10, r1, r4 - 0x004101B3**
6. **SLT r11, r2, r4 - 0x004102B3**
7. **ADDI r12, r4, 5 - 0x00520293**
8. **SW r3, r1, 2 - 0x0021A223**
9. **SRL r16, r14, r2 - 0x00271333**
10. **BNE r0, r1, 20 - 0x01410863**
11. **BEQ r0, r0, 15 - 0x00F00063**
12. **LW r13, r1, 2 - 0x00210103**
13. **SLL r15, r1, r2 - 0x00210133**