## **Given a 64-bit integer, find the position of the k-th set bit in O(1) time.**

This can be done using two SIMD instructions.

* First, using [PDEP](https://www.felixcloutier.com/x86/pdep), it is possible to get a number with only the bit that is set at the k-th position on the source number being set. In that end, a number with only the k-th bit set and the source number should be sent to the instructions, in that order. Therefore, each bit set on the source number will be cleared, except the k-th set bit.
* Diagram

  Description automatically generatedThen, using either [TZCNT](https://www.felixcloutier.com/x86/tzcnt) or [BSF](https://www.felixcloutier.com/x86/bsf) on the result, it is possible to get the number of bit not set on the right side of the set bit. In order to get the position of the bit, returning their result is sufficient for a 0-based position from the right.

Figure explaining the PDEP instruction

## **Given a 64-bit integer and a list of bit position, create a new 64-bit integer where the lowest bits are the extracted bits from the source integer at the given bit positions.**

This can also be done on two steps:

* First, creating a bitmask with the given positions using the [PCMPESTRM](https://www.felixcloutier.com/x86/pcmpestrm) instruction. This instruction should be called between 4 and 16 times, depending on the number of positions. The positions should be packed by group of 16 and compared with each of the groups {0…15}, {16…31}, {32…47} and {48…63}. The last argument should be \_SIDD\_UBYTE\_OPS | \_SIDD\_BIT\_MASK. The resulting bitmasks should then be accordingly shifted and OR-ed together.

Text

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* Diagram

  Description automatically generatedThen, using the [PEXT](https://www.felixcloutier.com/x86/pext) instruction to convert the given number. The PEXT instruction should be given as input the source number and the previously created mask in that order. From that, a new number will be created with the bits from the source number at the desired position packed together, as shown below.

1 1 1

Figure explaining the PEXT instruction