QuestionnaireGroup2

Thank you for taking part in this study which aims to understand the influence that visualization can have on the understanding of software behavior. You are kindly requested to answer 12 questions whose answers range from automatic completions to some calculations that you can do mentally. You can also use a calculator or an Excel spreadsheet. If you wish, you can answer this questionnaire anonymously by providing a pseudonym instead of your name. This study has received ethical certification from the Ethics Committee for Research with Human Beings of TELUQ University (CER-TELUQ) number 2022-08 of April 12, 2022.

A- Personal information, start date and start time of filling out the questionnaire

Q1- Name or pseudonym
yinglinLu

Q2-Date :
2022-05-20

Q3-Start time:
10:59 PM

C- Understanding the behavior of the vector instructions _mm512_mask_add_ps and _mm_shuffle_epi32

1- Vector instruction _mm512_mask_add_ps

Before answering questions Q7 and Q8, carefully observe and try to understand the figure below which is a screenshot of the SIMDGiraffe prototype, available online at https://github.com/pmntang/SIMDGiraffe. This screenshot is divided into three dials.

On the left dial there is a description of the instruction provided by Intel©.

On the lower dial, there is the graphical translation of this description. This translation consists in displaying for each of these vectors, its fields (or coordinates). We use the letters of the alphabet with subscripts (A0, A1, …B0, B1,…, ...) written inside blue rectangles to designate these fields. The graphic description is preceded on the line, to the left of the equality sign (=), by the name of the vector in question (src, k, a, b, r) and its type (__m512, __mmask16, __m512, __m512, __m512).

On the right-hand dial there is a visual description of the links between each field (or coordinates) of the result vector r and the fields (or coordinates) of the operand vectors used to calculate this field (or this coordinate). This description consists, as we can see, in giving for each field of the vector result r the calculation formula of that field from the operand fields used to carry out this calculation.

Q7- After observing the figure above, say what the _mm512_mask_add_ps instruction does by performing the following calculation: given src=(1, 3, 4, 1, 2, 5, 4, 1, 2, 3 , 4, 1, 1, 3, 4, 1); k=(1, 0, 0, 1, 1, 0, 0, 1, 0, 1, 1, 0, 0, 0, 1, 0); a=(6, 1, 2, 3, 1, 4, 5, 1, 2, 3, 4, 1, 3,1, 2, 1); b=(6, 1, 2, 3, 1, 4, 5, 1, 2, 3, 4, 1, 3,1, 2, 1) . Calculate r = _mm512_mask_add_ps(src, k, a, b)
r = (12, 3, 4, 6, 2, 5, 4, 2, 2, 6, 8, 1, 1, 3, 4, 1)

Q8- Using the figure above again, give a general formula for calculating the coordinates of r(ri) as function of those of src(srci), k(ki), a(ai) and b(bi)). ri=?
ri=Ei=(1-Bi) x Ai+Bi x (Ci+Di)=(1-ki) x srci+ki x (ai+bi)

2-Vector instruction _mm_shuffle_epi32

Before answering questions *Q9* and *Q10*, carefully observe and try to understand the figure below which is a screenshot of the SIMDGiraffe prototype, available online at https://github.com/pmntang/SIMDGiraffe. This screenshot is divided into three dials.

On the left dial there is a description of the instruction provided by Intel©.

On the lower dial, there is the graphical translation of this description. This translation consists in displaying for each of these vectors, its fields (or coordinates). We use the letters of the alphabet with subscripts (A0, A1, …B0, B1,…, ...) written inside blue rectangles to designate these fields. The description graphic is preceded on the line, to the left of the equality sign (=), by the name of the vector in question (a, imm8, r)

and its type (__m128i, int, __m128i).

On the right-hand dial there is a visual description of the links between each field (or coordinate) of the result vector r and the fields (or coordinates) of the operand vectors used to calculate this field (or this coordinate). This description consists, as we can see, in giving for each field of the vector result r the calculation formula of that field from the operand fields used to carry out this calculation.

Q9- After observing the figure above, say what the _mm_shuffle_epi32 instruction does by performing the following calculation: given a=(6, 7, 4, 3); imm8=(0, 1, 2, 3) . Calculate r = _mm_shuffle_epi32(a, imm8)
r = (3, 4, 7, 6)

Q10- Using the figure above again, give a general formula for calculating the coordinates of r(ri) as function of those of a(ai) and imm8(imm8i). ri=?
ri=Ci=Aj=aj, where j=Bi=imm8i

B- Preliminary knowledge

I- Knowledge of algebra and vector space

Consider the real vector space R3. For A, B, C, Res1, Res2, five vectors of R3 such that A=(a1, a2, a3), B=(b1, b2, b3), C=(c1, c2, c3), Res1=(x1, x2, x3), Res2=(y1, y2, y3) we define vectSum(A,B,C)=Res1 and vectProd(A,B,C)=Res2 by

$$\begin{cases} x_1 = a_1 - b_1 + c_1 \\ x_2 = a_2 - b_2 + c_2 \\ x_3 = a_3 - b_3 + c_3 \end{cases} \text{ and } \begin{cases} y_1 = b_1 \times (a_1 - c_1) + c_1 \\ y_2 = b_2 \times (a_2 - c_2) + c_2 \\ y_3 = b_3 \times (a_3 - c_3) + c_3 \end{cases}$$

Now let's assume that A=(1, 0,1) ; B=(1,1,0) ; C=(0,1, 1).

Q4- Calculate each of the Res1 and Res2 vectors: Res1= ? Res2=?
Res1=(0,0,2); Res2=(1,0,1).

Q5- Give a general formula for calculating the coordinates of Res1(xi) and Res2(yi) as a function of those of A (ai), B (bi) and C (ci). xi=? yi=?
xi=ai-bi+ci ; yi= bi x (ai-ci) + ci .

II- Knowledge of the C language

Consider the following function f in C: int f (int x, int y) {return x-y;}.

Q6- Choose the two instructions in C (that is, instruction1 and instruction2) which allow you to declare three integer variables a, b, c and to place in c the difference between a and b using the function f. instruction1: ? instruction2: ?
Instruction1: int c, a, b; Instruction2: c=f(a,b);

D- End time of the questionnaire completion and comments

Q11- End time:
11:19 PM

Q12- Other comments and remarks:
the description is intimidating, when it comes to answering the question, it seems simple