QuestionnaireGroup3

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

Before moving on to the next questions, these questions must be filled in first. Questions Q2 and Q3 are automatically filled in with the current date and current time respectively; hence, you only have to fill in Q1.

Q1- Name or pseudonym *

Name or pseudonym

Enter your name in the space above, or a pseudonym if you want to remain anonymous.

Q2-Date : *

2022-07-25

Q3-Start time: *

3:37 PM

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

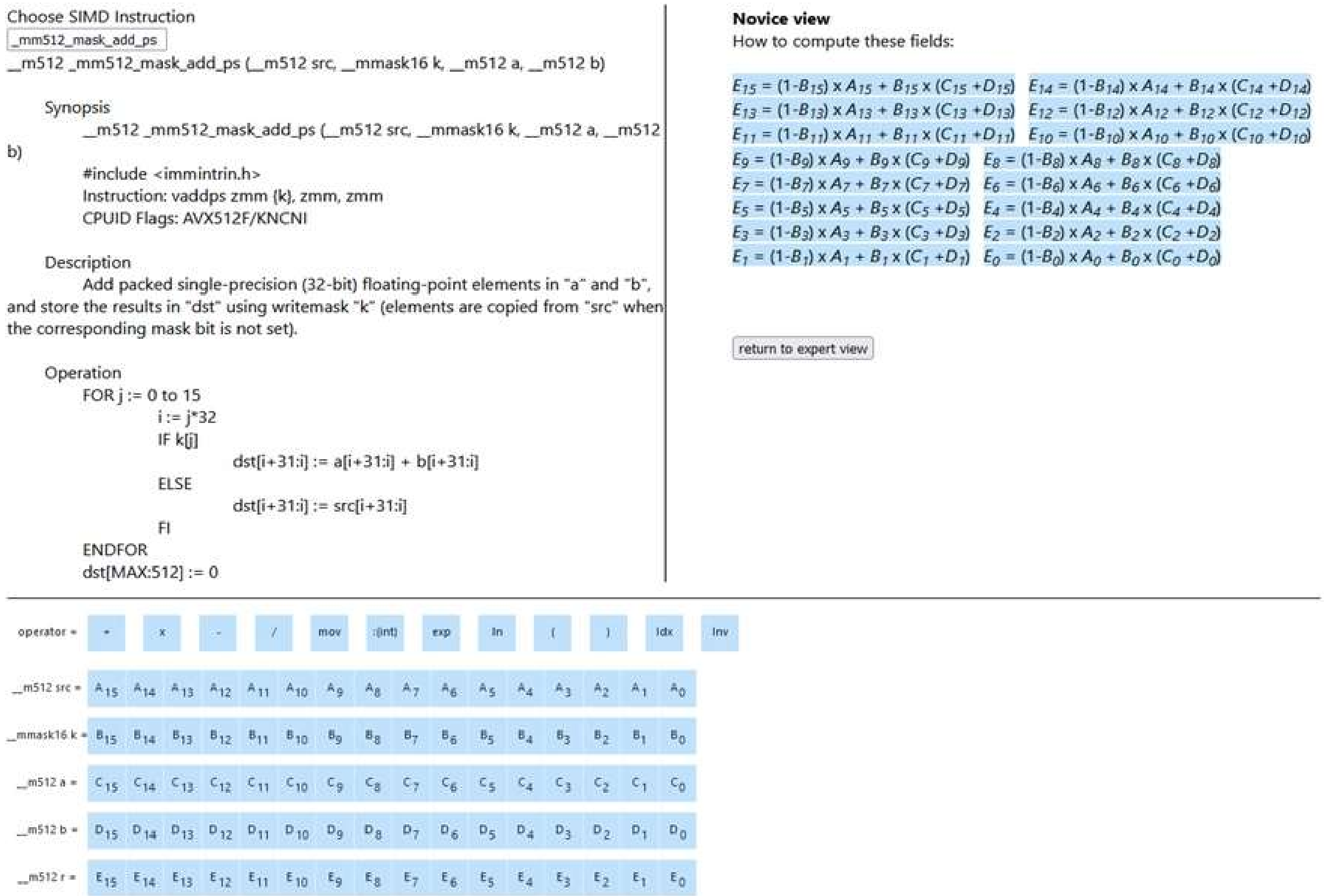
1- Vector instruction _mm512_mask_add_ps

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. You can also watch this short video which provides and explanation by an expert in the field of vector programming of this instruction: https://youtu.be/aoAX922SeGs



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 = (1, 0, 0, 1, 2, 0, 0, 1, 0, 3, 4, 0, 0, 0, 4, 0)
- r = (12, 2, 4, 6, 2, 8, 10, 2, 4, 6, 8, 2, 6, 2, 4, 0)
- r = (12, 3, 4, 6, 2, 5, 4, 2, 2, 6, 8, 1, 1, 3, 4, 1)
- r = (13, 0, 0, 7, 4, 0, 0, 3, 0, 9, 12, 0, 0, 0, 8, 0)

Check the radio button in front of the correct answer. You can use the right quadrant of the previous figure as a help.

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=Ci+Di=ai+bi
- ri=Ei=(1-Bi) x Ai+Ci+Di=(1-ki) x srci+ai+bi
- ri=Ei=(1-Bi) x Ai+Bi x (Ci+Di)=(1-ki) x srci+ki x (ai+bi)
- ri=Ei=Bi x Ai+(1-Bi) x (Ci+Di)=ki x srci+(1-ki) x (ai+bi)

Check the radio button in front of the correct answer; pay attention to the fact that on the previous figure r=(Ei)i=r(ri); b=(Di)i=b(bi); a=(Ci)i=a(ai); k=(Bi)i=k(ki); src=(Ai)i=src(srci). i being the index.

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. You can also watch this short video which provides and explanation by an expert in the field of vector programming of this instruction: https://www.youtube.com/watch?v=zSz_-eAI8MA

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 = (6, 2, 1, 3) ○ r = (6, 7, 4, 3) ○ r = (3, 4, 7, 6) ○ r = (3, 7, 4, 6)

Check the radio button in front of the correct answer. You can use the right quadrant of the previous figure as a help.

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=Aij=aij, where j=Bi=imm8i
- ◯ ri=Ci=Ai=ai
- ◯ ri=Ci=Ai x Bi=ai x imm8i
- ◯ ri=Ci=Aj=aj, where j=Bi=imm8i

Check the radio button in front of the correct answer; pay attention to the fact that on the previous figure r=(Ci)i=r(ri); a=(Ai)i=a(ai); imm8=(Bi)i=imm8(imm8i). i being the index.

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=(2,1,0); Res2=(1,1,0).
- ◯ Res1=(0,0,2); Res2=(1,0,1).
- ◯ Res1=(2,2,2); Res2=(1,1,1).
- ◯ Res1=(1,0,2); Res2=(0,0,1).

Check the radio button in front of the correct answer

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= ; yi= .

Write xi= ; yi= . Then, Write the expression of xi (respectively yi) as function of ai, bi and ci in the space following xi (respectively yi).

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);
- Instruction1: int c, a, b; Instruction2: {return c=f(a,b);}
- Instruction1: int c, a, b; Instruction2: c=f(a,b);
- Instruction1: int c, a, b; Instruction2: {return c=f(a-b);}

Check the radio button in front of the correct answer

D- End time of the questionnaire completion and comments

Before submitting the forms, these questions, in particular questions *Q18* must be filled in.

Q11- End time: *

End time

Fill in this field with the current time, to the nearest minute, when you have finished filling out the questionnaire and if you have completed it without interruption. If you have had interruptions, calculate the end time by deducting the duration of the total interruptions from the current time.

Q12- Other comments and remarks:

Fill in this field with your remarks, comments, and observations on any subject of interest in connection with the study, including the questionnaire, the SIMDGiraffe prototype, etc.

Submit