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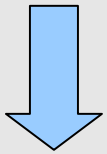
dco is a compiler post-processor
asm->asm

```
cc -c -O3 foo.c
```

```
.c.o:
    $(CC) $(CFLAGS) -c $<
```



```
cc -S -O3 foo.c
dco foo.s -o ofoo.s
mv ofoo.s foo.s
cc -c foo.s
rm foo.s
```

```
.c.o:
    $(CC) $(CFLAGS) -S $<
    dco $*.s -o $*.s $(DOPTS)
    $(CC) $(CFLAGS) -c $*.s
    rm $*.s
```

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- allows selective optimization
- optimizes optimized code
- takes full advantage of the options and features provided by the target processor

x86 offers the 'Single Instruction Multiple Data' (SIMD) instructions. The part of dco utilizing these instructions is called

SIMDinator (pronounced *seem-d-ney-ter*)

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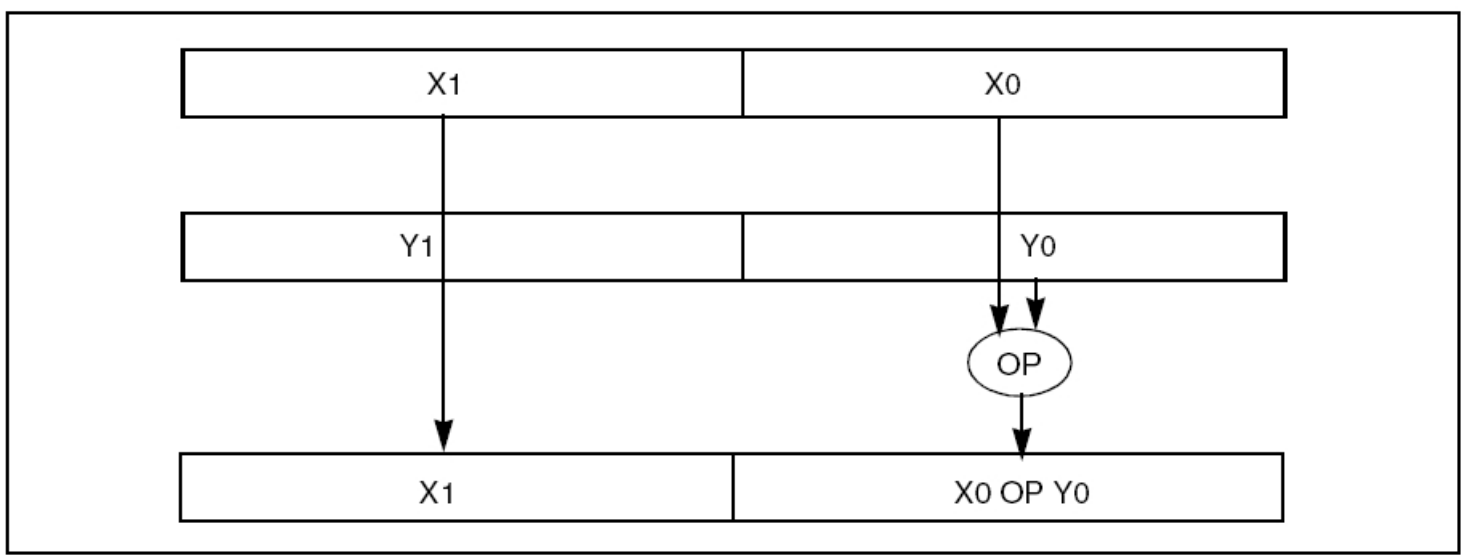
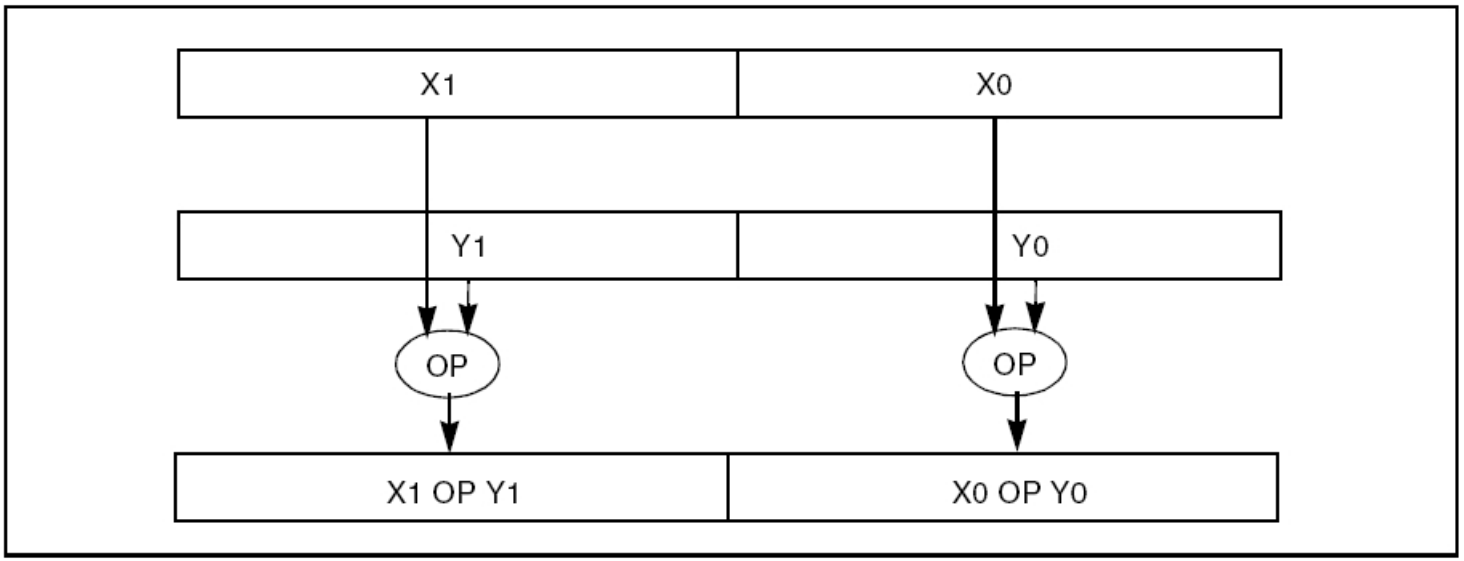


Scalar Double-Precision Floating-Point Operations

addsd
mulsd



Packed Double-Precision Floating-Point Operations

addpd
mulpd

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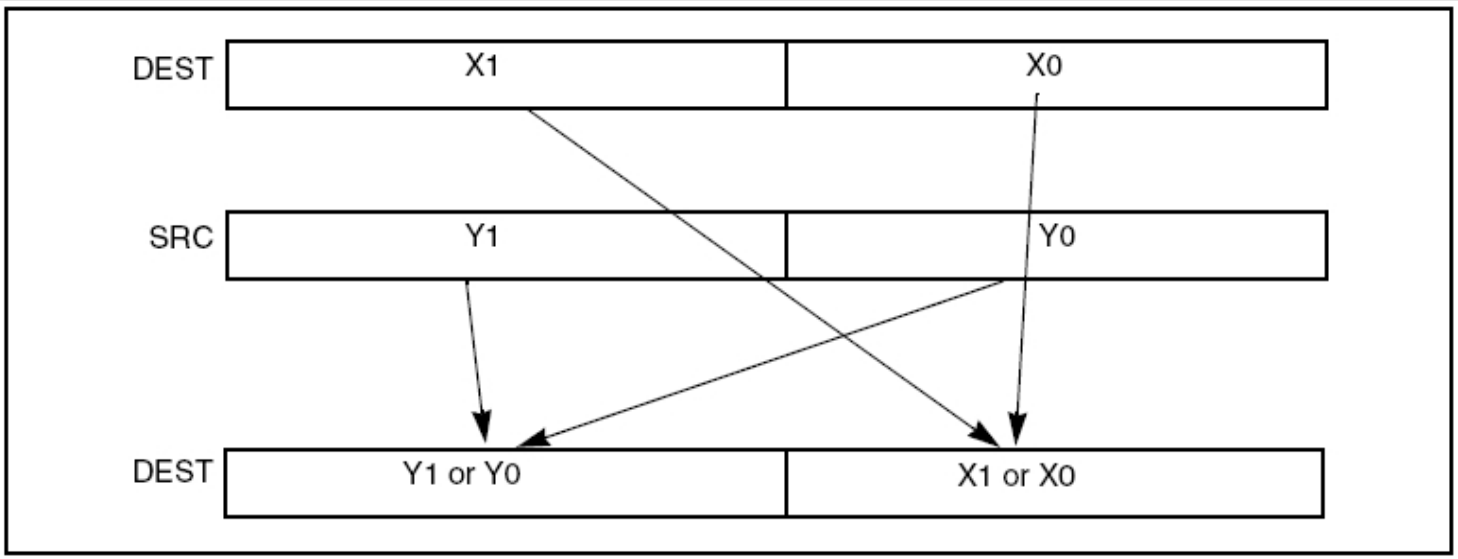

SHUFPD Instruction Packed Shuffle Operation

shufpd
unpcklpd

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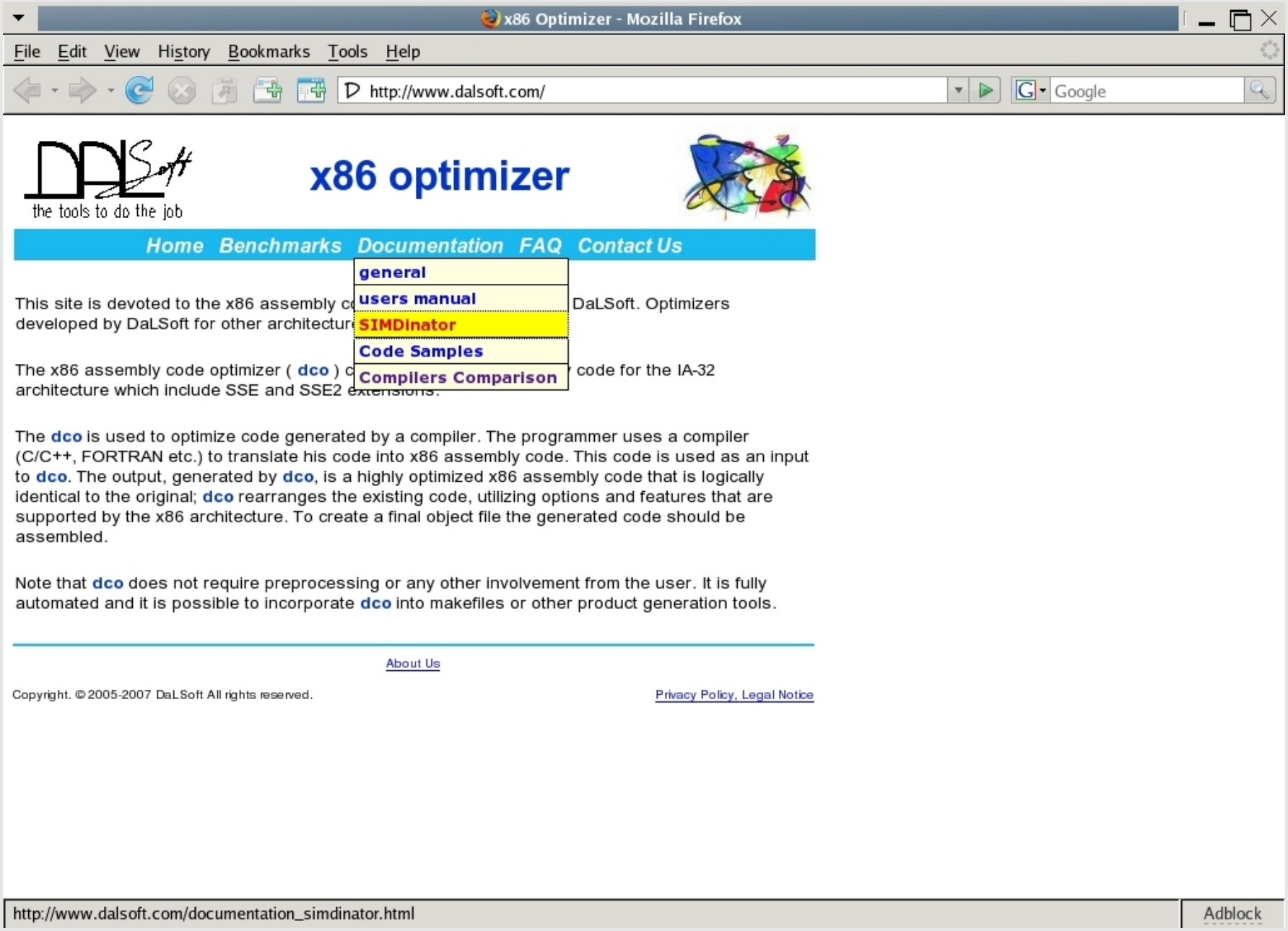

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SIMDinator makes code faster

Kernel#	gcc 4.1.2	gcc+dco	-np	gcc+dco/gcc	-np/gcc	-np/gcc+dco
1	4.96	3.32	4	33.06%	19.35%	-20.48%
2	2.38	2.32	2.32	2.52%	2.52%	0.00%
3	5.93	3.55	3.84	40.13%	35.24%	-8.17%
4	4.66	4.12	3.8	11.59%	18.45%	7.77%
5	5.2	2.07	2.07	60.19%	60.19%	0.00%
6	4.53	3.9	3.63	13.91%	19.87%	6.92%
7	4.87	3.12	3.96	35.93%	18.69%	-26.92%
8	5	5.4	3.88	-8.00%	22.40%	28.15%
9	4.6	3.95	4.23	14.13%	8.04%	-7.09%
10	4.94	3.87	3.38	21.66%	31.58%	12.66%
11	5.78	1.52	1.52	73.70%	73.70%	0.00%
12	5.18	4.98	4.39	3.86%	15.25%	11.85%
13	4.57	5.56	4.58	-21.66%	-0.22%	17.63%
14	4.71	4.71	4.26	0.00%	9.55%	9.55%
15	3.72	3.72	3.72	0.00%	0.00%	0.00%
16	5.61	5.31	5.29	5.35%	5.70%	0.38%
17	5.01	4.99	4.99	0.40%	0.40%	0.00%
18	4.7	3.96	3.95	15.74%	15.96%	0.25%
19	5.81	4.1	4.1	29.43%	29.43%	0.00%
20	4.53	4.43	4.43	2.21%	2.21%	0.00%
21	4.88	4.61	4.61	5.53%	5.53%	0.00%
22	4.88	6.21	4.86	-27.25%	0.41%	21.74%
23	4.17	4.09	4.09	1.92%	1.92%	0.00%
24	4.85	0.77	0.77	84.12%	84.12%	0.00%
Geometric Mean	**4.75**	**3.64**	3.53	**23.37%**	25.68%	3.02%

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```
for ( k=0 ; k<n ; k++ )
{
        x[k] = u[k] + r*( z[k] + r*y[k] ) +
                t*( u[k+3] + r*( u[k+2] + r*u[k+1] ) +
                        t*( u[k+6] + q*( u[k+5] + q*u[k+4] ) ) );
}
```

36%
faster

dco generated code

```
.L1012:
        leal as1+32032(,%edx,8),%eax
        unpcklpd %xmm3,%xmm3
        unpcklpd %xmm4,%xmm4
        unpcklpd %xmm5,%xmm5
___dcox86_wl_0_:
        movsd -31992(%eax),%xmm2
        addl $2,%edx
        movhpd -32000(%eax),%xmm2
        addl $16,%eax
        cmpl %ecx,%edx
        movsd -32000(%eax),%xmm7
        movhpd -32008(%eax),%xmm7
        movsd -32032(%eax),%xmm6
        movhpd -32040(%eax),%xmm6
        movsd -8(%eax),%xmm1
        movhpd -16(%eax),%xmm1
        mulpd %xmm4,%xmm2
        movsd 8000(%eax),%xmm0
        movhpd 7992(%eax),%xmm0
        addpd %xmm7,%xmm2
        movsd -32024(%eax),%xmm7
        movhpd -32032(%eax),%xmm7
        mulpd %xmm3,%xmm6
        mulpd %xmm4,%xmm2
        mulpd %xmm3,%xmm1
        addpd %xmm7,%xmm6
        movsd -31992(%eax),%xmm7
        movhpd -32000(%eax),%xmm7
        addpd %xmm0,%xmm1
        movsd -32040(%eax),%xmm0
        movhpd -32048(%eax),%xmm0
        mulpd %xmm3,%xmm6
        mulpd %xmm3,%xmm1
        addpd %xmm7,%xmm2
        movsd -32016(%eax),%xmm7
        movhpd -32024(%eax),%xmm7
        addpd %xmm0,%xmm1
        mulpd %xmm5,%xmm2
        addpd %xmm7,%xmm6
        addpd %xmm2,%xmm6
        mulpd %xmm5,%xmm6
        addpd %xmm6,%xmm1
        movhpd %xmm1,-8024(%eax)
        movsd %xmm1,-8016(%eax)
        jne ___dcox86_wl_0_
```

compiler generated code

```
.L1012:
        leal 1(%edx), %esi
        movapd %xmm3, %xmm6
        mulsd as1+32032(,%edx,8), %xmm6
        addsd as1+40040(,%edx,8), %xmm6
        mulsd %xmm3, %xmm6
        addsd as1(,%edx,8), %xmm6
        movapd %xmm3, %xmm1
        mulsd as1(,%esi,8), %xmm1
        addsd as1+16(,%edx,8), %xmm1
        mulsd %xmm3, %xmm1
        addsd as1+24(,%edx,8), %xmm1
        movapd %xmm4, %xmm0
        mulsd as1+24(,%esi,8), %xmm0
        addsd as1+32(,%esi,8), %xmm0
        mulsd %xmm4, %xmm0
        addsd as1+40(,%esi,8), %xmm0
        mulsd %xmm5, %xmm0
        addsd %xmm0, %xmm1
        mulsd %xmm5, %xmm1
        addsd %xmm1, %xmm6
        movsd %xmm6, as1+24016(,%esi,8)
        addl $2, %edx
        movapd %xmm3, %xmm6
        mulsd as1+32032(,%esi,8), %xmm6
        addsd as1+40040(,%esi,8), %xmm6
        mulsd %xmm3, %xmm6
        addsd as1(,%esi,8), %xmm6
        movapd %xmm3, %xmm7
        mulsd as1(,%edx,8), %xmm7
        addsd as1+16(,%esi,8), %xmm7
        mulsd %xmm3, %xmm7
        addsd as1+24(,%esi,8), %xmm7
        movapd %xmm4, %xmm2
        mulsd as1+24(,%edx,8), %xmm2
        addsd as1+32(,%edx,8), %xmm2
        mulsd %xmm4, %xmm2
        addsd as1+40(,%edx,8), %xmm2
        mulsd %xmm5, %xmm2
        addsd %xmm2, %xmm7
        mulsd %xmm5, %xmm7
        addsd %xmm7, %xmm6
        movsd %xmm6, as1+24016(,%edx,8)
        cmpl %ecx, %edx
        jne .L1012
```

SIMDinator makes code slower

Kernel#	gcc 4.1.2	gcc+dco	-np	gcc+dco/gcc	-np/gcc	-np/gcc+dco
1	4.96	3.32	4	33.06%	19.35%	-20.48%
2	2.38	2.32	2.32	2.52%	2.52%	0.00%
3	5.93	3.55	3.84	40.13%	35.24%	-8.17%
4	4.66	4.12	3.8	11.59%	18.45%	7.77%
5	5.2	2.07	2.07	60.19%	60.19%	0.00%
6	4.53	3.9	3.63	13.91%	19.87%	6.92%
7	4.87	3.12	3.96	35.93%	18.69%	-26.92%
8	5	5.4	3.88	-8.00%	22.40%	28.15%
9	4.6	3.95	4.23	14.13%	8.04%	-7.09%
10	4.94	3.87	3.38	21.66%	31.58%	12.66%
11	5.78	1.52	1.52	73.70%	73.70%	0.00%
12	5.18	4.98	4.39	3.86%	15.25%	11.85%
13	4.57	5.56	4.58	-21.66%	-0.22%	17.63%
14	4.71	4.71	4.26	0.00%	9.55%	9.55%
15	3.72	3.72	3.72	0.00%	0.00%	0.00%
16	5.61	5.31	5.29	5.35%	5.70%	0.38%
17	5.01	4.99	4.99	0.40%	0.40%	0.00%
18	4.7	3.96	3.95	15.74%	15.96%	0.25%
19	5.81	4.1	4.1	29.43%	29.43%	0.00%
20	4.53	4.43	4.43	2.21%	2.21%	0.00%
21	4.88	4.61	4.61	5.53%	5.53%	0.00%
22	4.88	6.21	4.86	-27.25%	0.41%	21.74%
23	4.17	4.09	4.09	1.92%	1.92%	0.00%
24	4.85	0.77	0.77	84.12%	84.12%	0.00%
Geometric Mean	**4.75**	**3.64**	3.53	23.37%	25.68%	3.02%

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SIMDinator prevents better code generation

Kernel#	gcc 4.1.2	gcc+dco	-np	gcc+dco/gcc	-np/gcc	-np/gcc+dco
1	4.96	3.32	4	33.06%	19.35%	-20.48%
2	2.38	2.32	2.32	2.52%	2.52%	0.00%
3	5.93	3.55	3.84	40.13%	35.24%	-8.17%
4	4.66	4.12	3.8	11.59%	18.45%	7.77%
5	5.2	2.07	2.07	60.19%	60.19%	0.00%
6	4.53	3.9	3.63	13.91%	19.87%	6.92%
7	4.87	3.12	3.96	35.93%	18.69%	-26.92%
8	5	5.4	3.88	-8.00%	22.40%	28.15%
9	4.6	3.95	4.23	14.13%	8.04%	-7.09%
10	4.94	3.87	3.38	21.66%	31.58%	12.66%
11	5.78	1.52	1.52	73.70%	73.70%	0.00%
12	5.18	4.98	4.39	3.86%	15.25%	11.85%
13	4.57	5.56	4.58	-21.66%	-0.22%	17.63%
14	4.71	4.71	4.26	0.00%	9.55%	9.55%
15	3.72	3.72	3.72	0.00%	0.00%	0.00%
16	5.61	5.31	5.29	5.35%	5.70%	0.38%
17	5.01	4.99	4.99	0.40%	0.40%	0.00%
18	4.7	3.96	3.95	15.74%	15.96%	0.25%
19	5.81	4.1	4.1	29.43%	29.43%	0.00%
20	4.53	4.43	4.43	2.21%	2.21%	0.00%
21	4.88	4.61	4.61	5.53%	5.53%	0.00%
22	4.88	6.21	4.86	-27.25%	0.41%	21.74%
23	4.17	4.09	4.09	1.92%	1.92%	0.00%
24	4.85	0.77	0.77	84.12%	84.12%	0.00%
Geometric Mean	**4.75**	**3.64**	**3.53**	23.37%	25.68%	3.02%

faster	29.00%
slower	12.50%
prevents	25.00%

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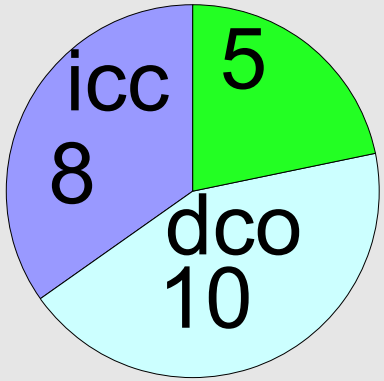
Kernel#	gcc 4.1.2	gcc+dco	icc	gcc+dco/gcc	icc/gcc	icc/gcc+dco
1	4.96	3.32	2.96	33.06%	40.32%	10.84%
2	2.38	2.32	2.28	2.52%	4.20%	1.72%
3	5.93	3.55	2.54	40.13%	57.17%	28.45%
4	4.66	3.8	4.63	18.45%	0.64%	-21.84%
5	5.2	2.07	2.38	60.19%	54.23%	-14.98%
6	4.53	3.63	3.87	19.87%	14.57%	-6.61%
7	4.87	3.12	2.57	35.93%	47.23%	17.63%
8	5	3.88	3.25	22.40%	35.00%	16.24%
9	4.6	3.95	4.97	14.13%	-8.04%	-25.82%
10	4.94	3.38	4.32	31.58%	12.55%	-27.81%
11	5.78	1.52	1.65	73.70%	71.45%	-8.55%
12	5.18	4.39	4.13	15.25%	20.27%	5.92%
13	4.57	4.58	4.61	-0.22%	-0.88%	-0.66%
14	4.71	4.26	2.3	9.55%	51.17%	46.01%
15	3.72	3.72	3.67	0.00%	1.34%	1.34%
16	5.61	5.29	5.66	5.70%	-0.89%	-6.99%
17	5.01	4.99	4.86	0.40%	2.99%	2.61%
18	4.7	3.95	3.45	15.96%	26.60%	12.66%
19	5.81	4.1	6.77	29.43%	-16.52%	-65.12%
20	4.53	4.43	4.38	2.21%	3.31%	1.13%
21	4.88	4.61	1.05	5.53%	78.48%	77.22%
23	4.17	4.09	4.67	1.92%	-11.99%	-14.18%
24	4.85	0.77	1.66	84.12%	65.77%	-115.58%
Geometric Mean	**4.74**	**3.4**	**3.29**	28.27%	30.56%	3.19%

Number of cases



Compiler generated information to aid optimization:

- aliasing
- failed register allocations
- alignment

Thank you!