A Brave New Parallel World

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Why Do We Need Something New ?

Existing parallel programming models all fail

We can't get the ultimate performance today

Given the hardware trend, we need prepare for scalability to at least 1,000,000,000 threads

Every application and developer is unique with specific needs

All of this needs to be supported

Need something different and better !

World's Only Unified New Development

WOUND

Open Source (obviously)

A Brave New Parallel World

Open WOUND

Open WOUND Goals

Extreme scalability

Extremely powerful

Always optimal performance

High level

Explicit language

Total control over everything

Can express uncertainty

Trivial to understand

What Is Wrong With This ?

Open WOUND

Traditional pragma based model:

```
#pragma omp <action>
```

This is an all or nothing model
Real-life is different

Open WOUND Differentiator

Confidence Levels !

This allows the developer to rely on the system to help out, while maintaining full control

Confidence Levels

Open WOUND adds a second dimension:

```
#pragma wound [confidence level] <action>
```

How To Define Parallelism ?

Start and end parallel execution

```
#pragma wound [confidence level] open
#pragma wound [confidence level] close
```

Confidence levels supported:

- ***always***
- ***maybe***
- ***sometimes***
- ***depends***
- ***not (to preserve sequential semantics !)***

Open WOUND's Differentiator

Confidence levels can be combined !

Examples Confidence Levels

```
#pragma wound maybe
#pragma wound maybe sometimes
#pragma wound maybe sometimes not
#pragma wound depends sometimes
#pragma wound depends not
#pragma wound not always depends
```

Current limitation is to only support 5 combinations (see the roadmap though)

Acknowledgement

What follows next has been inspired by the expressive power of some of the more elegant constructs from OpenMP 4.0

For example:

```
#pragma omp declare simd\
        aligned(a,b,c) \
        linear(e,f,g:18)
        simdlen(27) \
        inbranch
```

How About Open WOUND Then ?

Non-Expert Rapid Decision (NERD) controls

Successfully marries full control with ease of code development

Initially only support for:

superscalar level

pipeline scheduling order

preferred number of instructions

number of cache misses allowed: target and max

Simple Example Of NERD Control


```
#pragma nerd wound \
    superscalar(3) \
    pipeline(ex0,FPU1,ex1) \
    instructions(12) \
    cachemisses(t:0,m:123454321)
```

Open WOUND's Differentiator

NERD supports confidence levels !

Simple Example Of NERD Control/2

```
#pragma nerd wound\
  maybe superscalar(3) \
  pipeline(not ex0,always FPU1,ex1) \
  instructions(sometimes 12) \
  cachemisses(not t:0,m:123454321)
```

HURT – The Run Time System

Hybrid Unified Run Time (HURT) :

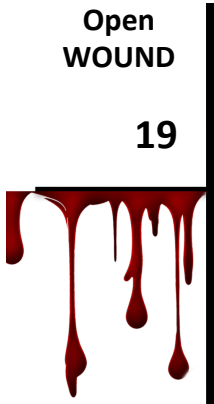
Handles everything for the user

Extremely powerful

Easy to use *

****) Incorrect use is fatal though***

Open WOUND - Environment Variables



```
WOUND GO_AHEAD [YES|NO]

HURT_WOUND [ALWAYS|SOMETIMES|NEVER]

NERD_WOUND [[CONFIDENCE LEVEL],TARGET]]
```

Example:

```
NERD_WOUND INSTRUCTIONS, NOT PIPELINE
```

Open WOUND - TEARS

Open WOUND

Totally Expressive Advanced Relational System (TEARS)

Symbolic debugger for Open WOUND

Example

(tears) STOP if perhaps not always

(tears) TEARS: program stopped

(tears) print handkerchief

(tears) TEARS: inconsistency detected

(tears) TEARS: conflict with "maybe depends"

Open WOUND – BANDAID

Two component SDK for rapid program development and deployment

BAND – Brave And Naive Developer

AID – Architecturally Independent Dependences

Open WOUND – STITCHES

Community Documentation Project *

Connects it all together
Dropped concept of page count
Uses "STAPLES" instead

**) Driven by initial user feedback. Personally I think Open WOUND is so easy, straightforward and obvious that it doesn't need documentation*

Hello World Example – Original Code


```
for (int i=0; i<n; i++)
   do_whatever_you_like(&i)

this_is_my_job_only()

always_the_same_answer()
```

Hello World Example – Prototype!


```
#pragma wound always open
  hurt_always(sometimes)
  #pragma nerd wound \
                superscalar(8) instructions(4) \
                pipeline(FPU0,not FPU1,MMU3) \
                cachemisses(t:4,m:666)
  for (int i=0; i<n; i++)
     do_whatever_you_like(&i)
  hurt_ends()

  #pragma wound never open
      this_is_my_job_only()
  #pragma wound always close

  #pragma wound maybe not
      always_the_same_answer()
#pragma wound sometimes close
```

Open WOUND - Status

- *WOUND is on ice*
- *HURT is fleshed out still*
- *TEARS code is trickling in*
- *BANDAID 0.9.1.7.3 has been patched for 1.0 release*
- *STITCHES is at 666 STAPLES (and growing)*

Public comment phase expected to start April 1, 2014

Open WOUND – Roadmap/1

- *WOUND*
  - ✓ *Plan 2 more actions for 1.1 release*
  - ✓ *Target for 1.1 is to support 200 confidence levels*
- *Massive increase of HURT at all levels*

Open WOUND – Roadmap/2

- ***BANDAID***
  - ✓ *BAND has been frozen*
  - ✓ *AID is on the cutting table*
- ***TEARS***
  - ✓ *Support 200 confidence levels in 1.1 release*
- ***STITCHES***
  - ✓ *Effort to automatically insert STAPLES*

Open WOUND

Come And See Us In New Orleans !

Open
WOUND

Thank You And ..... Stay Tuned !

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