Quick table to describe bugs, location and status.
Bug type: compilation (C) and numerical (N) bug.

#	Status	Folder	Type	Cause	Description
				T	Missing support for operators on FE fields
F3	Closed	b3	C	*T*	Inner/cross product
F12	Closed	b11	C	T	Tensor slicing
F5	OPEN	b5	C		Inside test
F17	OPEN		C	T	Division (r,v)
F20	OPEN		C	T	Double dot product
				E	EIN rep of FE fields
F6	Closed	b6	C	*E*	Summation not handled
F8	Closed	b8	C	*E*	Differential indices are constants
F8	Closed	b8	C	*E*	components ndices are constants
				CG	Issue in generated code to do point-wise eval
F1	Closed	b1	C	*CG*	Converting types
F7	Closed	b6	C	*CG*	Converting types
F4	Closed	b4	C	*CG*	Multiple creation of functions with the same name
F14	OPEN	b14	C	CG	Multiple creation of functions with the same name
F19	OPEN	b19	C	CG	Multiple creation of functions with the same name
F9	OPEN	b9	C	*CG*	Weird indexing tensors
F15	OPEN	b5	C	CG	Type error for helper function
F16	CLOSED	b16	N	CG	sampling outside mesh and derivative find cell
				DATm	issue in DATm results in a false positive
				Unknown	Not sure what the issue is
F2	Closed	b2	N		
F13	OPEN	b12 & b11	C		weird issue at run-time
F10	OPEN	b10	N		Hessian of addition (unknown)?

1 Questions

- Is F1 the same as F7?
- Is F4 the same as F14?
- How to describe F9 (weird indexing tensors) issue?
- How to describe F13 (weird run-time) issue?
- Should F16 be a code generation error or a logic error? Was there an issue translating the tree ir to generated code or something else?
- Hessian of addition still fails even when we kill polynomial order (k) value.

2 Comparisons

Can the bug be found with different approaches?

#	$Test_{differential}$	$Test_{equality}$	$Test_{property}$	$Test_{vis}$

3 Bugs in FEMprime branch

issue - top level description
computation - operators and arguments
output -terminal output (if helpful)
solution - how was it solved
details - of problem
versions svn version scope (error-solved)

Sections with * indicates the bug still needs to be better understood.

3.1 F1*

issue - Code generation issue when converting types

computation -|(∇(*F*0))|;
output .

```
ex1.cxx:798:16: error: no viable conversion from 'ex1::tensor_ref_2' to 'double'
        double l_probe_l_4_22 = makeEval_UnitSquareMesh_Lagrange_2_1(
                ^               ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
***rtn:compile __p_o25_o6_t1_tN_tN__l2
```

solution -?
details

3.2 F2*

issue Numerical error when taking the norm.
computation *normalize*(∇(*F*0))
output
solution
details

3.3 F3

issue Missing support for inner/cross product on ofields
computation
output
solution Add ofields (inner product) to typechecker
details Can not take inner-product of ofields

3.4 F4

issue Multiple creation of functions with the same name
computation gradient of a field
output terminal

```
ex1.cxx:423:17: error: redefinition of 'helpEvalBasis_UnitSquareMesh_Lagrange_2'
inline double * helpEvalBasis_UnitSquareMesh_Lagrange_2(const double *k...
```

solution
details

3.5 F5*

issue
computation
output terminal.

```
3pow TI (T0[])<(T0)^2>HighToMid.expandOp: error converting InsideFEM<3>
uncaught exception Bind [nonexhaustive binding failure]
  raised at common/phase-timer.sml:78.57-78.59
  raised at high-to-mid/high-to-mid.sml:203.105-203.107
  raised at high-to-mid/buil
```

solution
details Inside Error

3.6 F6

issue Translation in compiler EIN IR for Summation not handled
computation
output terminal.

```
3HighToMid.expandEINAPP: error converting out051A =    (F0[3],FNCSPACE1,FNCSPACE2,T3[3])<Prob
uncaught exception Subscript [subscript out of bounds]
  raised at common/phase-timer.sml:78.57-78.59
  raised at high-to-mid/high-to-mid.sml:216.7-216.9
  raised at Basis/Implementation/list.sml:78.35-78.44
make: *** [ex1.o] Error 1
cp: ex1.cxx: No such file or directory
cp: ex1.cxx: No such file or directory
***rtn:compile __p_o24_o1_t2_t2__l2
         -: trace(hessian)
        -_F_s_d3 |p_o24_o1_t2_t2__l2
        rtn:compile
```

solution
details Summation in a single term not handled correctly

3.7 F7*

issue conversion of types done incorrectly
computation
output terminal.

```
          ex1.cxx:870:6: error: no type named 'tensor_ref_3_3' in namespace 'ex1'
ex1::tensor_ref_3_3 s_makeEval_UnitCubeMesh_P_4_2(NodeTy nodes, newposTy b, coordTy c,int ce
~~~~~~^
ex1.cxx:876:14: error:
```

solution
details

3.8 F8

issue Differential indices are constants
computation det(concat2)
output terminal.

(F0[2],FNCSPACE1,FNCSPACE2,T3[3])<Probe(BuildFEM(T0_{'0'})_1[2]),T3)>

details Unhandled cases when using constant indices.Constant indices in field components
solution

3.9 F9*

issue Weird indexing tensors
computation
output terminal.

```
ex1.cxx:850:20: error: subscripted value is not an array, pointer, or vector
        H[0][0][0] = H0[0][0];
                     ~~~~~~^~
ex1.cxx:851:20: error: subscripted value is not an array, pointer, or vector
        H[0][1][0] = H0[1][0];
```

solution
details

3.10 F10

issue Issue unknown
computation
output terminal.

```
-p_o8_o24_t12_t2__l2 hessian(addition)| F_s_d3,F_s_d3|
Rst: Z-3 RD  max diff: 51.5896 sumdiff: 13.9962 67.4956% c:24.8443995169280 o:76.43399
```

solution
details

3.11 F11*

3.12 F12

issue
computation
output
solution
details

```
uncaught exception Fail [Fail: unknown type]
  raised at common/phase-timer.sml:78.57-78.59
  raised at driver/main.sml:84.76-84.79
  raised at typechecker/check-expr.sml:611.47-611.66
make: *** [ex1.o] Error 1
cp: ex1.cxx: No such file or directory
cp: ex1.cxx: No such file or directory


***rtn:compile __p_o23_o29_t2_tN_tN__l2
         -: slicev0(grad)
        -_F_s_d3 |p_o23_o29_t2_tN_tN__l2
        rtn:compile
```

3.13 F13

issue Unknown
computation
output Weird allocation error

```
python(24510,0x7fff796c2300) malloc: *** error for object 0x7ff48bbf7800: pointer being freed
*** set a breakpoint in malloc_error_break to debug
[Charisees-MacBook-Air:24510] *** Process received signal ***
[Charisees-MacBook-Air:24510] Signal: Abort trap: 6 (6)
[Charisees-MacBook-Air:24510] Signal code:  (0)
[Charisees-MacBook-Air:24510] [ 0] 0   libsystem_platform.dylib            0x00007fff88cd3f1a
[Charisees-MacBook-Air:24510] [ 1] 0   ???                                 0x0000000000000000
[Charisees-MacBook-Air:24510] [ 2] 0   libsystem_c.dylib                   0x00007fff88d439a3
[Charisees-MacBook-Air:24510] [ 3] 0   libsystem_malloc.dylib              0x00007fff8d8941cb
```

solution
details Error when creating a vector fields in python

3.14 F14

issue Multiple creation of functions with the same name
computation

output 0_tensor[2] compositionl,ex1.cxx:777:15: error: redefinition of 's_makeEval_Uni
inline double s_makeEval_UnitCubeMesh_Lagrange_4_(NodeTy nodes, newposT...
Makefile

solution
details

3.15 F15

issue
computation
output teriminal

.

```
observ.cxx:919:2: error: no matching function for call to
      'jIs_UnitSquareMesh_P_2'
        jIs_UnitSquareMesh_P_2(J,nM,pM,cell);
        ^~~~~~~~~~~~~~~~~~~~~~
observ.cxx:831:14: note: candidate function not viable: no known conversion from
      'double [2][2]' to 'double (*)[3]' for 1st argument
inline void *jIs_UnitSquareMesh_P_2(double J[3][3],MappTy nM, FloatMapT...
```

solution
details

3.16 F16

issue
computation
output
solution
details Sampling at the point [0,9.45187e+06] led to a find cell error, which was handled correctly, but the derivative code did not handle this case and segfaulted. The reason it sampled to far away was a mistake in FATm.