results not correct	
#	Description
F2	magnitude of a field
F10	Hessian of addition
F16	sampling outside mesh

Compilation issue **Missing support for operators on FE fields**	
#	Description
F3	Inner/cross product
F12	Tensor slicing
F5	Inside test
F17	Division (r,v)
F20	Double dot product

compilation issue **Internal representation of FE fields**	
#	Description
F6	Summation not handled
F8	Differential indices are constants
F8	components indices are constants
F21	Summation with indices in field component

compilation issue **Generated code for point-wise eval**	
#	Description
F1	Converting types
F7	Converting types
F4	Multiple creation of functions
F14	“
F19	“
F9	Weird indexing tensors
F15	Type error for helper function

Other	
#	Description
F1	run-time

Figure 1: Organization of bugs

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

#	Status	Folder	Description
F3	Closed	b3	Inner/cross product
F12	Closed	b11	Tensor slicing
F5	OPEN	b5	Inside test
F17	OPEN		Division (r,v)
F20	OPEN	b20	Double dot product
F6	Closed	b6	Summation not handled
F8	Closed	b8	Differential indices are constants
F8	Closed	b8	components ndices are constants
F1	Closed	b1	Converting types
F7	Closed	b6	Converting types
F4	Closed	b4	Multiple creation of functions with the same name
F14	OPEN	b14	Multiple creation of functions with the same name
F19	OPEN	b19	Multiple creation of functions with the same name
F9	OPEN	b9	Weird indexing tensors
F15	OPEN	b5	Type error for helper function
F16	CLOSED	b16	sampling outside mesh and derivative find cell
F2	Closed	b2	
F13	OPEN	b12 & b11	weird issue at run-time
F10	OPEN	b10	Hessian of addition (unknown)?
F21	CLOSED	b21	Summation with indices in field component
F22	CLOSED		det() indices needed reshifting
F23	OPEN	b23	codegen issue with type mismatch
F24	OPEN	b24	Numerically incorrect
			Somehow subtraction arguments are switched
F25	OPEN		

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 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.

2.1 F1*

issue - Code generation issue when converting types
computation -$|(\nabla(F0))|$;
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

2.2 F2*

issue Numerical error when taking the norm.
computation $normalize(\nabla(F0))$
output
solution
details

2.3 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

2.4 F4

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

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

solution Fixed in r5413: the solution was to realize that the gradient of a field and a field incorrectly both generated common functions and stop this.
details

2.5 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

2.6 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

2.7 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

2.8 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

2.9 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

2.10 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

2.11 F11*

2.12 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
```

2.13 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

2.14 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

2.15 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

2.16 F16

issue Accidental sampling outside of a cell leads to a segfault in derivative code
computation Any level of differentiation and a sampling outside of the mesh will cause this error.
output MPI reads out a segfault.
solution Add check in the derivative code for outside of the mesh sampling
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.

2.17 F21

issue Numerical error.
computation Trace
output terminal

```
***rtn:terrible__p_o0_o6_t16_tN_tN__l2
        -: trace(none)
       -
-p_o0_o6_t16_tN_tN__l2 trace(none)| F_m2x2_d2|
                Rst: Z-3 RD  max diff: 7.486 sumdiff: 4.3919 172.2781% c:-3.14070000000000 o
       rtn:terrible
```

solution splitting summation of probe. then creating own operator. shifting upper bound +1.
details Summation with indices in field component

2.18 F22

```
-p_o0_o7_t16_tN__l2 det(none)| F_m2x2_d2| Rst: V-0 RA
```

Field component has two constant indices. cutting function in float was not organizing indices correctly.
python fem.py 3 0 7 23 (again with -3d case)

2.19 F23

```
le __p_o0_o8_t16_tN__l2
        -: inverse(none)

1ex1.cxx:838:41: error: no matching function for call to 's_2_2makeEval_UnitSquareMesh_P_2_'
      tensor_ref_2_2 l_probe_l_4_24 = s_2_2makeEval_UnitSquareMesh_P_2_(l_node_23, l_newpos_22
                                      ^~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
ex1.cxx:655:21: note: candidate function not viable: no known conversion from 'ex1::tensor_ref_2
     (aka 'double *') for 2nd argument
ex1::tensor_ref_2_2 s_2_2makeEval_UnitSquareMesh_P_2_(NodeTy nodes, newposTy b, coordTy c ){
                    ^
ex1.cxx:853:43: error: use of undeclared identifier 's_2makeEval_UnitSquareMesh_P_2_'; did you m
     's_2_2makeEval_UnitSquareMesh_P_2_'?
      tensor_ref_2 l_probe_l_4_33 = s_2makeEval_UnitSquareMesh_P_2_(l_node_23, l_newpos_22
                                    ^~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
                                    s_2_2makeEval_UnitSquareMesh_P_2_
```

2.20 F24

Issue Code gen error

Computation Derivative of a tensor field i.e if you pass a tensor field from Firedrake and takes its derivative in Diderot

Output It crashes warning of a double free. I don't have this on hand. Try the commit r5403 to see it. I forget the commit that fixed it .

solution Stopped any functions from delete memory allocated for newpos.

details Evaluation functions assumed that they were the last ones to get a bit of memory (the memory for the new position; allocated in the translate coordinates process) and so they delete it too soon.