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

#	Status	Folder	Description
			Compilation issue(C)-Type checker
F3	Closed	b3	Inner/cross product
F5	Closed	b5	Inside test
F12	OPEN	b11	Tensor slicing
F17	OPEN		Division (r,v)
F20,F27	Closed	b20	Double dot product missing between field and matrix
-	Closed	b15	Outer product between vector and field
			Compilation issue(C)-internal rep
F6	Closed	b6	Summation not handled (trace hessian)
F8	Closed	b8	Differential indices are constants (det concat)
	Closed		Differentiation of Trace (similar to F6)
F31	Closed		recreating sliced term. indices aren't correct
F32	Closed		second index is constant. (case not handled)
F33	Closed		composition of an ofield
			Compilation issue(C)-generated code
F1	Closed	b1	Converting types
F4	Closed	b4	gradient of a field and field gen same name
F7	Closed	b6	Converting types
F9	Closed	b9	Weird indexing tensors
F28	Closed	$\tilde{\text{b}}$19	fnname:different shapes create same eval-scalar
F29	Closed		fnname:affineDeriv created multiple
F23,F30	Closed	b23	missing reference types
-	Closed	-	missing reference type (does not represent shape post differentiation)
			Run-time issue(R)
F13	OPEN	b12 & b11	pointer free error
F16	CLOSED	b16	sampling outside mesh and derivative find cell
F15	OPEN	b5,b14	Segmentation Violation
			Numerically incorrect(N)
F2	Closed	b2	normalize op. error left from merge
F10	OPEN	b10,b18	Hessian of addition (unknown)?
F21	CLOSED	b21	Summation components not accounted for (trace)
F22	CLOSED		det() indices needed reshifting
F24	OPEN	b24	subtraction args are switched
F25	OPEN	Needs entry	Memory related tensor derivative error
F26	UNCLEAR	b26	Numerical Problem when using float
			unsorted

1 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.

1.1 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

1.2 F2*

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

1.3 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

1.4 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

1.5 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

1.6 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

1.7 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
~~~~~^
ex1.cxx:876:14: error:
```

solution
details

1.8 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

1.9 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

1.10 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

1.11 F11*

1.12 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
```

1.13 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            0x00007fff88cd3f1
[Charisees-MacBook-Air:24510] [ 1] 0   ???                                 0x0000000000000000
[Charisees-MacBook-Air:24510] [ 2] 0   libsystem\_c.dylib                   0x00007fff88d439a
[Charisees-MacBook-Air:24510] [ 3] 0   libsystem\_malloc.dylib              0x00007fff8d8941c
```

solution
details Error when creating a vector fields in python

1.14 F15

issue
computation
output teriminal

.

```
[0]PETSC ERROR: ------------------------------------------------------------------------
[0]PETSC ERROR: Caught signal number 11 SEGV: Segmentation Violation, probably memory access
[0]PETSC ERROR: Try option -start_in_debugger or -on_error_attach_debugger
[0]PETSC ERROR: or see http://www.mcs.anl.gov/petsc/documentation/faq.html#valgrind
[0]PETSC ERROR: or try http://valgrind.org on GNU/linux and Apple Mac OS X to find memory co
[0]PETSC ERROR: configure using --with-debugging=yes, recompile, link, and run
[0]PETSC ERROR: to get more information on the crash.
--------------------------------------------------------------------------
```

solution
details

1.15 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.

1.16 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

1.17 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)

1.18 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\_2
                                            ^~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
ex1.cxx:655:21: note: candidate function not viable: no known conversion from 'ex1::tensor\_ref\
      (aka 'double *') for 2nd argument
ex1::tensor\_ref\_2\_2 s\_2\_2makeEval\_UnitSquareMesh\_P\_2\_(NodeTy nodes, newposTy b, coordTy
                      ^
ex1.cxx:853:43: error: use of undeclared identifier 's\_2makeEval\_UnitSquareMesh\_P\_2\_'; did y
      's\_2\_2makeEval\_UnitSquareMesh\_P\_2\_'?
            tensor\_ref\_2 l\_probe\_l\_4\_33 = s\_2makeEval\_UnitSquareMesh\_P\_2\_(l\_node\_23
                                               ^~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
                                                s\_2\_2makeEval\_UnitSquareMesh\_P\_2\_
```

1.19 F24

Issue Subtraction args are switched

Computation Subtracting one field from another

Output t__p_o0_o10_t14_t14__l2

observed data from femprime/ [[0.1088, -3.8392, -4.5563998], [-1.4155999, -2.8296001, -5.998

correct data from python[[-0.108800000000000, 3.83920000000000, 4.55640000000000], [1.4156000

positions[[0.46, 0.38], [0.41, 0.14], [0.82, 0.63], [0.41, 0.87], [0.56, 0.58], [0.48, 0.52

```
Params(2)

-p\_o0\_o10\_t14\_t14\_\_l2 subtraction(none)| F\_v3\_d2,F\_v3\_d2|
                    Rst: Z-3 RD  max diff: 15.2328 sumdiff: 6.8524 200.0% c:7.61640000000000 o:-
```

1.20 F25

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.

1.21 F26

Issue Code gen or floating point problem

Computation Regular pointwise evaluation

Output Numerically incorrect results on various combinations of points and FE data

Solution Kick the can by using doubles

F27 11/11/17 - double dot product missing between field and matrix
python2 fem.py 4 1 15 17 5
compile issue

[ex1.diderot:10.18-30] Error: type error for arguments of binary
operator ":" found: (OField#4(2)[3,3] * mat3)

F28 - error with generated code names. different sizes created same methods
for scalar field.

F29 11/26/17 - error with generated code names
differet names for affine (depends on space) for scalar and shape (even though no differences), but because it is derived when main constructor is different (isScalar)
affineDerv_UnitSquareMesh_P_4_1_p ***rtn:compile __p_o12_o35_t39_tN_tN__l2 -: jacob(division) -_F_v2_d2,F_s_d2 —p_o12_o35_t
rtn:compile

F30 11/27/17 - error with generated code -missing types
erorr:slice a tensor field [n]. missing n type declaration. fix:when we see evalShape(shape) then we addTy (Ty.TensorRefTy shape); ********** type difference ***rtn:compile __p_o32_o1_t7_tN_tN__l2 -: neg(slicev1) -_F_v3_d2 —p_o32_o1_t7_tN_tN__l2ex1.
error: no member named 'tensor_ref_3' in namespace 'ex1' return(ex1::tensor_ref_3((double*) H));

rtn:compile

F31 -p_o29_o38_t7 curl(slicem0)— F_m3x3_d3—
rtn:terrible
(F0[3 3],FNCSPACE1,FNCSPACE2,T3[3])¡Probe(BuildFEM(T0_'1',i0)_1[2]_i1),T3)¿_3 3
(F0[3 3],FNCSPACE1,FNCSPACE2,T3[3])¡Probe(BuildFEM(T0_i2,i1)_1[2]_i2),T3)¿_3 3 3

shifting isnt done correctly when there is a cut.

F32 F_[0c] del_1. Jacob M1.
constant is second index. missing case.

F33 compose(inverse)
-_F_m2x2_d3,F_v3_d3 —p_o8_o36_t6_t20_tN__l2 Missing case for summation of a probe with composition in float.