NAME

mul − multiply a matrix by a column vector, row vector by a matrix, or matrix by a matrix

SYNOPSIS

```
float4 mul(float4x4 M, float4 v);
float4 mul(float4x3 M, float3 v);
float4 mul(float4x2 M, float2 v);
float4 mul(float4x1 M, float1 v);
float3 mul(float3x4 M, float4 v);
float3 mul(float3x3 M, float3 v);
float3 mul(float3x2 M, float2 v);
float3 mul(float3x1 M, float1 v);
float2 mul(float2x4 M, float4 v);
float2 mul(float2x3 M, float3 v);
float2 mul(float2x2 M, float2 v);
float2 mul(float2x1 M, float1 v);
float1 mul(float1x4 M, float4 v);
float1 mul(float1x3 M, float3 v);
float1 mul(float1x2 M, float2 v);
float1 mul(float1x1 M, float1 v);

float4 mul(float4 v, float4x4 M);
float4 mul(float3 v, float3x4 M);
float4 mul(float2 v, float2x4 M);
float4 mul(float1 v, float1x4 M);
float3 mul(float4 v, float4x3 M);
float3 mul(float3 v, float3x3 M);
float3 mul(float2 v, float2x3 M);
float3 mul(float1 v, float1x3 M);
float2 mul(float4 v, float4x2 M);
float2 mul(float3 v, float3x2 M);
float2 mul(float2 v, float2x2 M);
float2 mul(float1 v, float1x2 M);
float1 mul(float4 v, float4x1 M);
float1 mul(float3 v, float3x1 M);
float1 mul(float2 v, float2x1 M);
float1 mul(float1 v, float1x1 M);

half4 mul(half4x4 M, half4 v);
half4 mul(half4x3 M, half3 v);
half4 mul(half4x2 M, half2 v);
half4 mul(half4x1 M, half1 v);
half3 mul(half3x4 M, half4 v);
half3 mul(half3x3 M, half3 v);
half3 mul(half3x2 M, half2 v);
half3 mul(half3x1 M, half1 v);
half2 mul(half2x4 M, half4 v);
half2 mul(half2x3 M, half3 v);
half2 mul(half2x2 M, half2 v);
half2 mul(half2x1 M, half1 v);
half1 mul(half1x4 M, half4 v);
half1 mul(half1x3 M, half3 v);
half1 mul(half1x2 M, half2 v);
half1 mul(half1x1 M, half1 v);

half4 mul(half4 v, half4x4 M);
half4 mul(half3 v, half3x4 M);
half4 mul(half2 v, half2x4 M);
half4 mul(half1 v, half1x4 M);
```

```
half3 mul(half4 v, half4x3 M);
half3 mul(half3 v, half3x3 M);
half3 mul(half2 v, half2x3 M);
half3 mul(half1 v, half1x3 M);
half2 mul(half4 v, half4x2 M);
half2 mul(half3 v, half3x2 M);
half2 mul(half2 v, half2x2 M);
half2 mul(half1 v, half1x2 M);
half1 mul(half4 v, half4x1 M);
half1 mul(half3 v, half3x1 M);
half1 mul(half2 v, half2x1 M);
half1 mul(half1 v, half1x1 M);

fixed4 mul(fixed4x4 M, fixed4 v);
fixed4 mul(fixed4x3 M, fixed3 v);
fixed4 mul(fixed4x2 M, fixed2 v);
fixed4 mul(fixed4x1 M, fixed1 v);
fixed3 mul(fixed3x4 M, fixed4 v);
fixed3 mul(fixed3x3 M, fixed3 v);
fixed3 mul(fixed3x2 M, fixed2 v);
fixed3 mul(fixed3x1 M, fixed1 v);
fixed2 mul(fixed2x4 M, fixed4 v);
fixed2 mul(fixed2x3 M, fixed3 v);
fixed2 mul(fixed2x2 M, fixed2 v);
fixed2 mul(fixed2x1 M, fixed1 v);
fixed1 mul(fixed1x4 M, fixed4 v);
fixed1 mul(fixed1x3 M, fixed3 v);
fixed1 mul(fixed1x2 M, fixed2 v);
fixed1 mul(fixed1x1 M, fixed1 v);

fixed4 mul(fixed4 v, fixed4x4 M);
fixed4 mul(fixed3 v, fixed3x4 M);
fixed4 mul(fixed2 v, fixed2x4 M);
fixed4 mul(fixed1 v, fixed1x4 M);
fixed3 mul(fixed4 v, fixed4x3 M);
fixed3 mul(fixed3 v, fixed3x3 M);
fixed3 mul(fixed2 v, fixed2x3 M);
fixed3 mul(fixed1 v, fixed1x3 M);
fixed2 mul(fixed4 v, fixed4x2 M);
fixed2 mul(fixed3 v, fixed3x2 M);
fixed2 mul(fixed2 v, fixed2x2 M);
fixed2 mul(fixed1 v, fixed1x2 M);
fixed1 mul(fixed4 v, fixed4x1 M);
fixed1 mul(fixed3 v, fixed3x1 M);
fixed1 mul(fixed2 v, fixed2x1 M);
fixed1 mul(fixed1 v, fixed1x1 M);

float1x1 mul(float1x1 A, float1x1 B);
float1x2 mul(float1x1 A, float1x2 B);
float1x3 mul(float1x1 A, float1x3 B);
float1x4 mul(float1x1 A, float1x4 B);

float1x1 mul(float1x2 A, float2x1 B);
float1x2 mul(float1x2 A, float2x2 B);
float1x3 mul(float1x2 A, float2x3 B);
float1x4 mul(float1x2 A, float2x4 B);

float1x1 mul(float1x3 A, float3x1 B);
float1x2 mul(float1x3 A, float3x2 B);
```

```
float1x3 mul(float1x3 A, float3x3 B);
float1x4 mul(float1x3 A, float3x4 B);

float1x1 mul(float1x4 A, float4x1 B);
float1x2 mul(float1x4 A, float4x2 B);
float1x3 mul(float1x4 A, float4x3 B);
float1x4 mul(float1x4 A, float4x4 B);

float2x1 mul(float2x1 A, float1x1 B);
float2x2 mul(float2x1 A, float1x2 B);
float2x3 mul(float2x1 A, float1x3 B);
float2x4 mul(float2x1 A, float1x4 B);

float2x1 mul(float2x2 A, float2x1 B);
float2x2 mul(float2x2 A, float2x2 B);
float2x3 mul(float2x2 A, float2x3 B);
float2x4 mul(float2x2 A, float2x4 B);

float2x1 mul(float2x3 A, float3x1 B);
float2x2 mul(float2x3 A, float3x2 B);
float2x3 mul(float2x3 A, float3x3 B);
float2x4 mul(float2x3 A, float3x4 B);

float2x1 mul(float2x4 A, float4x1 B);
float2x2 mul(float2x4 A, float4x2 B);
float2x3 mul(float2x4 A, float4x3 B);
float2x4 mul(float2x4 A, float4x4 B);

float3x1 mul(float3x1 A, float1x1 B);
float3x2 mul(float3x1 A, float1x2 B);
float3x3 mul(float3x1 A, float1x3 B);
float3x4 mul(float3x1 A, float1x4 B);

float3x1 mul(float3x2 A, float2x1 B);
float3x2 mul(float3x2 A, float2x2 B);
float3x3 mul(float3x2 A, float2x3 B);
float3x4 mul(float3x2 A, float2x4 B);

float3x1 mul(float3x3 A, float3x1 B);
float3x2 mul(float3x3 A, float3x2 B);
float3x3 mul(float3x3 A, float3x3 B);
float3x4 mul(float3x3 A, float3x4 B);

float3x1 mul(float3x4 A, float4x1 B);
float3x2 mul(float3x4 A, float4x2 B);
float3x3 mul(float3x4 A, float4x3 B);
float3x4 mul(float3x4 A, float4x4 B);

float4x1 mul(float4x1 A, float1x1 B);
float4x2 mul(float4x1 A, float1x2 B);
float4x3 mul(float4x1 A, float1x3 B);
float4x4 mul(float4x1 A, float1x4 B);

float4x1 mul(float4x2 A, float2x1 B);
float4x2 mul(float4x2 A, float2x2 B);
float4x3 mul(float4x2 A, float2x3 B);
float4x4 mul(float4x2 A, float2x4 B);

float4x1 mul(float4x3 A, float3x1 B);
```

```
float4x2 mul(float4x3 A, float3x2 B);
float4x3 mul(float4x3 A, float3x3 B);
float4x4 mul(float4x3 A, float3x4 B);

float4x1 mul(float4x4 A, float4x1 B);
float4x2 mul(float4x4 A, float4x2 B);
float4x3 mul(float4x4 A, float4x3 B);
float4x4 mul(float4x4 A, float4x4 B);
```

PARAMETERS

M	Matrix
v	Vector
A	Matrix
B	Matrix

DESCRIPTION

Returns the vector result of multiplying a matrix *M* by a column vector *v*; a row vector *v* by a matrix *M*; or a matrix *A* by a second matrix *B*.

The following are algebrically equal (if not necessarily numerically equal):

```
mul(M,v) == mul(v, tranpose(M))
mul(v,M) == mul(tranpose(M), v)
```

REFERENCE IMPLEMENTATION

mul for a **float4x3** matrix by a **float3** column vector could be implemented this way:

```
float4 mul(float4x3 M, float3 v)
{
  float4 r;

  r.x = dot( M._m00_m01_m02, v );
  r.y = dot( M._m10_m11_m12, v );
  r.z = dot( M._m20_m21_m22, v );
  r.w = dot( M._m30_m31_m32, v );

  return r;
}
```

PROFILE SUPPORT

mul is supported in all profiles except the fp20, ps_1_1, ps_1_2, and ps_1_3 fragment profiles.

The **fixed3** matrix-by-vector and vector-by-matrix multiplies are very efficient in the fp30 profile.

SEE ALSO

cross, dot, transpose