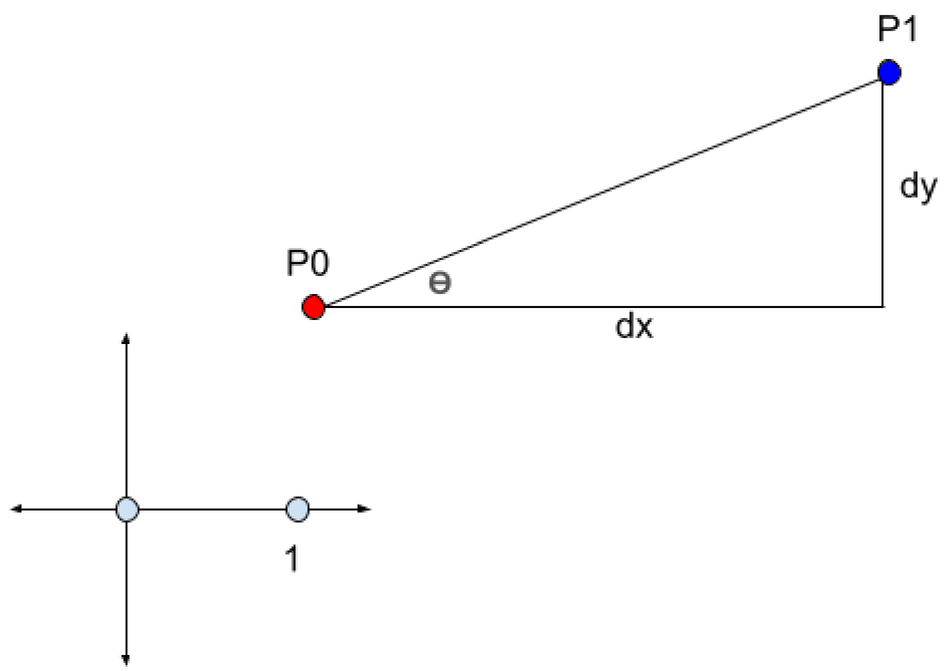
Linear Gradient Transformation

We define our simple Linear Gradient as follows:

Two points : P0 and P1
Two colors: C0 and C1

How can we create a transformation (matrix) that maps from the unit interval (0, 0) … (1, 0) to our gradient points?



We will create the mapping in 3 steps.

1. scale the unit interval to be the same length as the line between P0...P1

```
dx = P1.x - P0.x
dy = P1.y - P0.y
D = sqrt( dx^2 + dy^2 )

[ D 0 0 ]
[ 0 D 0 ]
[ 0 0 1 ]
```

2. rotate the line (0, 0) … (D, 1) to be parallel to the line P0 … P1

```
[ cos(θ) -sin(θ)  0 ]
[ sin(θ)  cos(θ)  0 ]
[   0       0     1 ]
```

We haven't computed θ yet, but we don't need to, since we don't really want θ but we want its sine and cosine.

Remember that cosine and Sine are defined as ratios of our triangle

```
cos(θ) = dx / D
sin(θ) = dy / D
```

Hence we can write this matrix as:

```
[ dx/D -dy/D 0 ]
[ dy/D  dx/D 0 ]
[   0     0  1 ]
```

3. translate so that the origin maps to P0

```
[ 1 0 P0.x ]
[ 0 1 P0.y ]
[ 0 0  1   ]
```

We now concatenate these 3 separate transformations in this order, to create a single matrix.

```
[ 1 0 P0.x ] [ dx/D -dy/D 0 ] [ D 0 0 ]
[ 0 1 P0.y ] [ dy/D  dx/D 0 ] [ 0 D 0 ]
[ 0 0  1   ] [   0     0  1 ] [ 0 0 1 ]
```

which concatenates into

```
[ dx -dy P0.x ]
[ dy  dx P0.y ]
[  0   0  1   ]
```

This is the transformation that maps the unit X-axis (1, 0) onto our line-segment between P0 and P1.