

## [Solution] W state

Author: [Seung-Sup Lee](#)

### Solution to Exercise (a): Tensor representation of the W state

The tensor representation of the W state for a general qubit number  $N$  can be generated with just two lines of code!

```
A = zeros(2*ones(1,N)); % define a rank-N tensor
A(2.^(0:N-1)+1) = 1/sqrt(N); % assign coefficients
```

Let's check whether it works.

```
N = 5;
A = zeros(2*ones(1,N));
A(2.^(0:N-1)+1) = 1/sqrt(N);
nnz(A) % number of nonzero elements
```

```
ans = 5
```

```
A(2,1,1,1,1)*sqrt(N)
```

```
ans = 1
```

```
A(1,2,1,1,1)*sqrt(N)
```

```
ans = 1
```

```
A(1,1,2,1,1)*sqrt(N)
```

```
ans = 1
```

```
A(1,1,1,2,1)*sqrt(N)
```

```
ans = 1
```

```
A(1,1,1,1,2)*sqrt(N)
```

```
ans = 1
```