# GetPauliStringReformatted

```
SetDirectory @ NotebookDirectory[];
Import["../Link/QuESTlink.m"];
```

## Doc

```
? GetPauliStringReformatted
```

Symbol

Reformats symbolic Pauli strings into a variety of other formats convenient for processing.

GetPauliStringReformatted[product, "Index"] returns the integer index of the given Pauli product in the ordered basis of Pauli products. The zero target is treated as least significant.

GetPauliStringReformatted[string, "Index"] returns a list of {index, coefficient} pairs which describe all Pauli products in the given string.

GetPauliStringReformatted[product, "Kronecker"] expands the Pauli product into an explicit Kronecker form. The zero target in the given product corresponds to the rightmost Pauli in the Kronecker form.

GetPauliStringReformatted[string, "Kronecker"] returns a list of {kronecker, coefficient} pairs; one for each term in the given Pauli string.

GetPauliStringReformatted[..., "String"] returns a compact, string–form of the "Kronecker" format.

GetPauliStringReformatted[..., numQubits] expands the "Kronecker" and "String" formats to the specified number of qubits, by padding with Id operators.

## Correctness

## Index

### Product

```
GetPauliStringReformatted[Id_4, "Index"]
0
```

```
GetPauliStringReformatted[X_0, "Index"]
GetPauliStringReformatted[Y_0, "Index"]
GetPauliStringReformatted[Z_0, "Index"]
```

```
1
```

```
2
```

```
3
```

```
GetPauliStringReformatted[X_1, "Index"]
GetPauliStringReformatted[Id_5 X_1 Id_0, "Index"]
```

```
4
```

```
4
```

```
GetPauliStringReformatted[Z_34, "Index"] === 3 × 4^34
```

```
True
```

```
p = Product[Z_t, {t, 0, 34}];
GetPauliStringReformatted[p, "Index" ] === 4^(34+1) - 1
```

```
True
```

```
ind = 1 245 194;
str = GetPauliString[ind]
ind === GetPauliStringReformatted[str, "Index"]
```

```
X_10 Y_0 Y_1 Z_8
```

```
True
```

## String

```
GetPauliStringReformatted[X_0 + a Y_0 + Z_3 X_0 + a X_0 b Y_2 c Z_4, "Index"]
```

```
{{1, 1}, {2, a}, {193, 1}, {801, a b c}}
```

```
GetPauliStringReformatted[X_0 + a z X_0, "Index"]
```

```
{{1, 1}, {1, a z}}
```

```
GetPauliStringReformatted[ Z_3 X_0 , "Index"]
GetPauliStringReformatted[ X_0 Y_2 Z_4, "Index"]
GetPauliStringReformatted[X_0 + a Y_0 + Z_3 X_0 + a X_0 b Y_2 c Z_4, "Index"]
```

```
193
```

```
801
```

```
{{1, 1}, {2, a}, {193, 1}, {801, a b c}}
```

```
GetPauliStringReformatted[ X_0 , "Index"]
GetPauliStringReformatted[ 1. X_0 , "Index"]
```

```
1
```

```
{{1, 1.}}
```

# Kronecker

## Product

```
GetPauliStringReformatted[X_0, "Kronecker"]
GetPauliStringReformatted[Z_0, "Kronecker"]
```

```
⊗X
```

```
⊗Z
```

```
GetPauliStringReformatted[X_1, "Kronecker"]
```

```
X ⊗ Id
```

```
GetPauliStringReformatted[X_1, 3, "Kronecker"]
GetPauliStringReformatted[X_1, "Kronecker", 4]
```

```
Id ⊗ X ⊗ Id
```

```
Id ⊗ Id ⊗ X ⊗ Id
```

```
GetPauliStringReformatted[X_0 Y_1 Z_2 Id_3, "Kronecker"]
```

```
Id ⊗ Z ⊗ Y ⊗ X
```

```
GetPauliStringReformatted[Z_9, "Kronecker"]
```

```
Z ⊗ Id ⊗ Id ⊗ Id ⊗ Id ⊗ Id ⊗ Id ⊗ Id ⊗ Id ⊗ Id
```

```
GetPauliStringReformatted[X_0 Y_1 Z_2 Id_3, 10, "Kronecker"]
```

```
Id ⊗ Id ⊗ Id ⊗ Id ⊗ Id ⊗ Id ⊗ Id ⊗ Z ⊗ Y ⊗ X
```

```
str = X_0 Y_1 Z_2 X_3 Y_4;
```

```
matr = KroneckerProduct @@ (PauliMatrix[# /. {Id → 0, X → 1, Y → 2, Z → 3}] & /@
      GetPauliStringReformatted[str, "Kronecker"]);
```

```
matr === Normal @ CalcPauliExpressionMatrix[str]
```

```
True
```

## String

```
GetPauliStringReformatted[   X_0 Y_1 Z_2 Id_3, "Kronecker"]
GetPauliStringReformatted[1. X_0 Y_1 Z_2 Id_3, "Kronecker"]
GetPauliStringReformatted[a  X_0 Y_1 Z_2 Id_3, "Kronecker"]
```

```
Id ⊗ Z ⊗ Y ⊗ X
```

```
{{Id ⊗ Z ⊗ Y ⊗ X, 1.}}
```

```
{{Id ⊗ Z ⊗ Y ⊗ X, a}}
```

**str = a $X_0 Y_1 Z_2 Id_3$ + b c $X_4$ + d e f $Y_0$ + $Z_0$ + $X_1 Z_4$;**
**GetPauliStringReformatted[str, "Kronecker"]**

{{X⊗Id⊗Id⊗Id⊗Id, b c}, {Id⊗Id⊗Id⊗Id⊗Y, d e f},
 {Id⊗Id⊗Id⊗Id⊗Z, 1}, {Id⊗Id⊗Z⊗Y⊗X, a}, {Z⊗Id⊗Id⊗X⊗Id, 1}}

# String

## Product

**GetPauliStringReformatted[$X_0 Y_1 Z_2$, "String"]**

ZYX

**GetPauliStringReformatted[$X_0 Y_1 Z_2$, 10, "String"]**

IIIIIIIZYX

**GetPauliStringReformatted[$Z_{40}$, "String"]**

ZIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII

## String

```
str = GetRandomPauliString[4, 5]
GetPauliStringReformatted[str, "String"]
GetPauliStringReformatted[str, "String", 10]
```

$-0.997255 X_2 X_3 Y_0 + 0.653767 X_1 X_2 X_3 Y_0 -$
$0.744804 Z_0 Z_2 + 0.0592989 Y_1 Z_0 Z_2 - 0.284251 X_2 Y_1 Z_0 Z_3$

```
{{XXIY, -0.997255}, {XXXY, 0.653767},
 {IZIZ, -0.744804}, {IZYZ, 0.0592989}, {ZXYZ, -0.284251}}
```

```
{{IIIIIIXXIY, -0.997255}, {IIIIIIXXXY, 0.653767},
 {IIIIIIIZIZ, -0.744804}, {IIIIIIIZYZ, 0.0592989}, {IIIIIIZXYZ, -0.284251}}
```

# Errors

**GetPauliStringReformatted[$Z_{10}$, 10, "String"]**

⋯ GetPauliStringReformatted: The given Pauli string targeted a larger index qubit than the number of qubits specified.

```
$Failed
```

**GetPauliStringReformatted[$X_{-1} Y_0$ + $X_2$, "Index"]**

⋯ GetPauliStringReformatted: Invalid arguments. See ?GetPauliStringReformatted

```
$Failed
```

**GetPauliStringReformatted[$X_1$, "Index", 3]**

GetPauliStringReformatted : Invalid arguments. See ?GetPauliStringReformatted

$Failed

**GetPauliStringReformatted[$X_{-1}$]**

GetPauliStringReformatted : Invalid arguments. See ?GetPauliStringReformatted

$Failed

**GetPauliStringReformatted[$X_2$, "BadMethod"]**

GetPauliStringReformatted : Invalid arguments. See ?GetPauliStringReformatted

$Failed

**GetPauliStringReformatted[$X_2$, 1, "Kronecker"]**

GetPauliStringReformatted : The given Pauli string targeted a larger index qubit than the number of qubits specified.

$Failed

**GetPauliStringReformatted[$X_0$ $X_0$, "Index"]**
**GetPauliStringReformatted[$X_0$ $Y_0$, "Index"]**

GetPauliStringReformatted : Invalid arguments. See ?GetPauliStringReformatted

$Failed

GetPauliStringReformatted : Invalid arguments. See ?GetPauliStringReformatted

$Failed

**GetPauliStringReformatted[1]**

GetPauliStringReformatted : Invalid arguments. See ?GetPauliStringReformatted

$Failed

**GetPauliStringReformatted[]**

GetPauliStringReformatted : Invalid arguments. See ?GetPauliStringReformatted

$Failed