Tensor Views

PyTorch allows a tensor to be a `View` of an existing tensor. View tensor shares the same underlying data with its base tensor. Supporting `View` avoids explicit data copy, thus allows us to do fast and memory efficient reshaping, slicing and element-wise operations.

For example, to get a view of an existing tensor `t`, you can call `t.view(...)`.

```
>>> t = torch.rand(4, 4)
>>> b = t.view(2, 8)
>>> t.storage().data_ptr() == b.storage().data_ptr()  # `t` and `b` share the same underlying data.
True
# Modifying view tensor changes base tensor as well.
>>> b[0][0] = 3.14
>>> t[0][0]
tensor(3.14)
```

Since views share underlying data with its base tensor, if you edit the data in the view, it will be reflected in the base tensor as well.

Typically a PyTorch op returns a new tensor as output, e.g. :meth:`~torch.Tensor.add`. But in case of view ops, outputs are views of input tensors to avoid unnecessary data copy. No data movement occurs when creating a view, view tensor just changes the way it interprets the same data. Taking a view of contiguous tensor could potentially produce a non-contiguous tensor. Users should pay additional attention as contiguity might have implicit performance impact. :meth:`~torch.Tensor.transpose` is a common example.

```
>>> base = torch.tensor([[0, 1],[2, 3]])
>>> base.is_contiguous()
True
>>> t = base.transpose(0, 1)  # `t` is a view of `base`. No data movement happened here.
# View tensors might be non-contiguous.
>>> t.is_contiguous()
False
# To get a contiguous tensor, call `.contiguous()` to enforce
# copying data when `t` is not contiguous.
>>> c = t.contiguous()
```

For reference, here's a full list of view ops in PyTorch:

- Basic slicing and indexing op, e.g. `tensor[0, 2:, 1:7:2]` returns a view of base `tensor`, see note below.
- :meth:`~torch.Tensor.adjoint`

- :meth:`~torch.Tensor.as_strided`

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- :meth:`~torch.Tensor.detach`

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- :meth:`~torch.Tensor.diagonal`

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- :meth:`~torch.Tensor.expand`

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- :meth:`~torch.Tensor.expand_as`

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- :meth:`~torch.Tensor.movedim`

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- :meth:`~torch.Tensor.narrow`

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- :meth:`~torch.Tensor.permute`

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- :meth:`~torch.Tensor.select`

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- :meth:`~torch.Tensor.squeeze`

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- :meth:`~torch.Tensor.transpose`

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- :meth:`~torch.Tensor.t`

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- :attr:`~torch.Tensor.T`

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- :attr:`~torch.Tensor.H`

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- :attr:`~torch.Tensor.mT`

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- :attr:`~torch.Tensor.mH`

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- :attr:`~torch.Tensor.real`

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- :attr:`~torch.Tensor.imag`

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line 69); *backlink*

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- :meth:`~torch.Tensor.view_as_real`

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  `resources\pytorch-master\docs\source\[pytorch-master][docs][source]tensor_view.rst,`
  line 70); *backlink*

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- :meth:`~torch.Tensor.unflatten`

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  `resources\pytorch-master\docs\source\[pytorch-master][docs][source]tensor_view.rst,`
  line 71); *backlink*

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- :meth:`~torch.Tensor.unfold`

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  `resources\pytorch-master\docs\source\[pytorch-master][docs][source]tensor_view.rst,`
  line 72); *backlink*

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- :meth:`~torch.Tensor.unsqueeze`

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  `resources\pytorch-master\docs\source\[pytorch-master][docs][source]tensor_view.rst,`
  line 73); *backlink*

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- :meth:`~torch.Tensor.view`

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  `resources\pytorch-master\docs\source\[pytorch-master][docs][source]tensor_view.rst,`
  line 74); *backlink*

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- :meth:`~torch.Tensor.view_as`

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  `resources\pytorch-master\docs\source\[pytorch-master][docs][source]tensor_view.rst,`
  line 75); *backlink*

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- :meth:`~torch.Tensor.unbind`

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  `resources\pytorch-master\docs\source\[pytorch-master][docs][source]tensor_view.rst,`
  line 76); *backlink*

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- :meth:`~torch.Tensor.split`

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  `resources\pytorch-master\docs\source\[pytorch-master][docs][source]tensor_view.rst,`

- :meth:`~torch.Tensor.hsplit`

- :meth:`~torch.Tensor.vsplit`

- :meth:`~torch.Tensor.tensor_split`

- :meth:`~torch.Tensor.split_with_sizes`

- :meth:`~torch.Tensor.swapaxes`

- :meth:`~torch.Tensor.swapdims`

- :meth:`~torch.Tensor.chunk`

- :meth:`~torch.Tensor.indices` (sparse tensor only)

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- :meth:`~torch.Tensor.values` (sparse tensor only)

> **Note**
>
> When accessing the contents of a tensor via indexing, PyTorch follows Numpy behaviors that basic indexing returns views, while advanced indexing returns a copy. Assignment via either basic or advanced indexing is in-place. See more examples in Numpy indexing documentation.

It's also worth mentioning a few ops with special behaviors:

- :meth:`~torch.Tensor.reshape`, :meth:`~torch.Tensor.reshape_as` and :meth:`~torch.Tensor.flatten` can return either a view or new tensor, user code shouldn't rely on whether it's view or not.

- :meth:`~torch.Tensor.contiguous` returns **itself** if input tensor is already contiguous, otherwise it returns a new contiguous tensor by copying data.

For a more detailed walk-through of PyTorch internal implementation, please refer to ezyang's blogpost about PyTorch Internals.