Package 'luz'

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Title Higher Level 'API' for 'torch'

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Description A high level interface for 'torch' providing utilities to reduce the the amount of code needed for common tasks, abstract away torch details and make the same code work on both the 'CPU' and 'GPU'. It's flexible enough to support expressing a large range of models. It's heavily inspired by 'fastai' by Howard et al. (2020) <arXiv:2002.04688>, 'Keras' by Chollet et al. (2015) and 'Pytorch Lightning' by Falcon et al. (2019) <doi:10.5281/zenodo.3828935>.

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`accelerator` *Create an accelerator*

Description

Create an accelerator

Usage

```
accelerator(device_placement = TRUE, cpu = FALSE)
```

Arguments

device_placement	(logical) whether the accelerator object should handle device placement. Default: TRUE
cpu	(logical) whether the training procedure should run on the CPU.

---

context *Context object*

Description

Context object storing information about the model training context. See also ctx.

Active bindings

`records` stores information about values logged with `self$log`.

`device` allows querying the current accelerator device

Methods

Public methods:

- `context$log()`
- `context$log_metric()`
- `context$get_log()`
- `context$get_metrics()`
- `context$get_metric()`
- `context$get_formatted_metrics()`
- `context$get_metrics_df()`
- `context$set_verbose()`
- `context$clone()`

Method `log()`**:** Allows logging arbitrary information in the `ctx`.

Usage:

```
context$log(what, set, value, index = NULL, append = TRUE)
```

Arguments:

`what` (string) What you are logging.

`set` (string) Usually 'train' or 'valid' indicating the set you want to lot to. But can be arbitrary info.

`value` value to log

`value` Arbitrary value to log.

`index` Index that this value should be logged. If `NULL` the value is added to the end of list, otherwise the index is used.

append If TRUE and a value in the corresponding index already exists, then value is appended to the current value. If FALSE value is overwritten in favor of the new value.

Method `log_metric()`**:** Log a metric gen its name and value. Metric values are indexed by epoch.

Usage:

```
context$log_metric(name, value)
```

Arguments:

name name of the metric

value value to log

value Arbitrary value to log.

Method `get_log()`**:** Get an specific value from the log.

Usage:

```
context$get_log(what, set, index = NULL)
```

Arguments:

what (string) What you are logging.

set (string) Usually 'train' or 'valid' indicating the set you want to lot to. But can be arbitrary info.

index Index that this value should be logged. If NULL the value is added to the end of list, otherwise the index is used.

Method `get_metrics()`**:** Get all metric given an epoch and set.

Usage:

```
context$get_metrics(set, epoch = NULL)
```

Arguments:

set (string) Usually 'train' or 'valid' indicating the set you want to lot to. But can be arbitrary info.

epoch The epoch you want to extract metrics from.

Method `get_metric()`**:** Get the value of a metric given its name, epoch and set.

Usage:

```
context$get_metric(name, set, epoch = NULL)
```

Arguments:

name name of the metric

set (string) Usually 'train' or 'valid' indicating the set you want to lot to. But can be arbitrary info.

epoch The epoch you want to extract metrics from.

Method `get_formatted_metrics()`**:** Get formatted metrics values

Usage:

```
context$get_formatted_metrics(set, epoch = NULL)
```

Arguments:

`set` (string) Usually 'train' or 'valid' indicating the set you want to lot to. But can be arbitrary info.

`epoch` The epoch you want to extract metrics from.

Method `get_metrics_df()`**:** Get a data.frame containing all metrics.

Usage:

```
context$get_metrics_df()
```

Method `set_verbose()`**:** Allows setting the `verbose` attribute.

Usage:

```
context$set_verbose(verbose = NULL)
```

Arguments:

`verbose` boolean. If `TRUE` verbose mode is used. If `FALSE` non verbose. if `NULL` we use the result of `interactive()`.

Method `clone()`**:** The objects of this class are cloneable with this method.

Usage:

```
context$clone(deep = FALSE)
```

Arguments:

`deep` Whether to make a deep clone.

`ctx` *Context object*

Description

Context objects used in luz to share information between model methods, metrics and callbacks.

Details

The `ctx` object is used in luz to share information between the training loop and callbacks, model methods and metrics. The table below describes information available in the `ctx` by default. Other callbacks could potentially modify these attributes or add new ones.

Attribute	Description
`verbose`	The value (`TRUE` or `FALSE`) attributed to the `verbose` argument in `fit` .
`accelerator`	Accelerator object used to query the correct device to place models, data, and etc. It assumes the value pas
`model`	Initialized `nn_module` object that will be trained during the `fit` procedure.
`optimizers`	A named list of optimizers used during training.
`data`	Dataloader passed to the `data` argument in `fit`. Modified to yield data in the selected device.
`valid_data`	Dataloader passed to the `valid_data` argument in `fit`. Modified to yield data in the selected device.
`epochs`	Total number of epochs the model will be trained on.
`epoch`	Current training epoch.
`iter`	Current training iteration. It's reset every epoch and when going from training to validation.
`training`	Whether the model is in training or validation mode. See also `help("luz_callback_train_valid")`

callbacks	List of callbacks that will be called during the training procedure. It's the union of the list passed to the ca
step	Closure that will be used to do one step of the model. It's used for both training and validation. Takes no
call_callbacks	Call callbacks by name. For example call_callbacks("on_train_begin") will call all callbacks that p
batch	Last batch obtained by the dataloader. A batch is a list() with 2 elements, one that is used as input and
input	First element of the last batch obtained by the current dataloader.
target	Second element of the last batch obtained by the current dataloader.
pred	Last predictions obtained by ctx$model$forward . **Note:** can be potentially modified by previously ran c
loss	Last computed loss from the model. **Note:** this might not be available if you modified the training or valid
opt	Current optimizer, ie. optimizer that will be used to do the next step to update parameters.
opt_nm	Current optimizer name. By default it's opt , but can change if your model uses more than one optimizer
metrics	list() with current metric object that are updated at every on_train_batch_end() or on_valid_batch
records	list() recording metric values for training and validation for each epoch. See also help("luz_callback
handlers	A named list() of handlers that is passed to rlang::with_handlers() during the training loop and can

Context attributes

See Also

Context object: context

`fit.luz_module_generator` *Fit a* `nn_module`

Description

Fit a `nn_module`

Usage

```
## S3 method for class 'luz_module_generator'
fit(
  object,
  data,
  epochs = 10,
  callbacks = NULL,
  valid_data = NULL,
  accelerator = NULL,
  verbose = NULL,
  ...
)
```

Arguments

object	An nn_module that has been setup().
data	(dataloader) A dataloader created with torch::dataloader() used for training the model. The dataloader must return a list with at most 2 items. The first item will be used as input for the module and the second will be used as target for the loss function.
epochs	(int) The number of epochs for training the model.
callbacks	(list, optional) A list of callbacks defined with luz_callback() that will be called during the training procedure. The callbacks luz_callback_metrics(), luz_callback_progress() and luz_callback_train_valid() are always added by default.
valid_data	(dataloader, optional) A dataloader created with torch::dataloader() that will be used during the validation procedure.
accelerator	(accelerator, optional) An optional accelerator() object used to configure device placement of the components like nn_modules, optimizers and batches of data.
verbose	(logical, optional) An optional boolean value indicating if the fitting procedure should emmit output to the console during training. By default, it will produce output if interactive() is TRUE, otherwise it won't print to the console.
...	Currently unused,

Value

A fitted object that can be saved with luz_save() and can be printed with print() and plotted with plot().

---

luz_callback *Create a new callback*

Description

Create a new callback

Usage

```
luz_callback(
  name = NULL,
  ...,
  private = NULL,
  active = NULL,
  parent_env = parent.frame(),
  inherit = NULL
)
```

Arguments

name	name of the callback
...	Public methods of the callback. The name of the methods is used to know how they should be called. See the details section.
private	An optional list of private members, which can be functions and non-functions.
active	An optional list of active binding functions.
parent_env	An environment to use as the parent of newly-created objects.
inherit	A R6ClassGenerator object to inherit from; in other words, a superclass. This is captured as an unevaluated expression which is evaluated in parent_env each time an object is instantiated.

Details

Let's implement a callback that prints 'Iteration n' (where n is the iteration number) for every batch in the training set and 'Done' when an epoch is finished. For that task we use the luz_callback function:

```
print_callback <- luz_callback(
  name = "print_callback",
  initialize = function(message) {
    self$message <- message
  },
  on_train_batch_end = function() {
    cat("Iteration ", ctx$iter, "\n")
  },
  on_epoch_end = function() {
    cat(self$message, "\n")
  }
)
```

luz_callback() takes a named list of function as argument where the name indicate the moment at which the callback should be called. For instance on_train_batch_end() is called for every batch at the end of the training procedure and on_epoch() end is called at the end of every epoch.

The returned value of luz_callback() is a function that initializes an instance of the callback. Callbacks can have initialization parameters, like the name of a file you want to log the results, in this case, you can pass an initialize method when creating the callback definition and save these parameters to the self object. In the above example, the callback has a message parameter that is printed at the end of each epoch.

Once a callback is defined it can be passed to the fit function via the callbacks parameter, eg:

```
fitted <- net %>%
  setup(...) %>%
  fit(..., callbacks = list(
    print_callback(message = "Done!")
  ))
```

Callbacks can be called in many different positions of the training loop, including a combinations of them. Here's an overview of possible callback *breakpoints*:

```
Start Fit
   - on_fit_begin
  Start Epoch Loop
     - on_epoch_begin
    Start Train
       - on_train_begin
      Start Batch Loop
         - on_train_batch_begin
          Start Default Training Step
            - on_train_batch_after_pred
            - on_train_batch_after_loss
            - on_train_batch_before_backward
            - on_train_batch_before_step
            - on_train_batch_after_step
          End Default Training Step:
         - on_train_batch_end
      End Batch Loop
       - on_train_end
    End Train
    Start Valid
       - on_valid_begin
      Start Batch Loop
         - on_valid_batch_begin
          Start Default Validation Step
            - on_valid_batch_after_pred
            - on_valid_batch_after_loss
          End Default Validation Step
         - on_valid_batch_end
      End Batch Loop
       - on_valid_end
    End Valid
      - on_epoch_end
  End Epoch Loop
   - on_fit_end
End Fit
```

Every step market with a on_* is a point in the training procedure that is available for callbacks to be called.

The other important part of callbacks is the `ctx` (context) object. See `help("ctx")` for details.

Value

A `luz_callback` that can be passed to `fit.luz_module_generator()`.

See Also

Other luz_callbacks: luz_callback_csv_logger(), luz_callback_early_stopping(), luz_callback_interrupt(), luz_callback_lr_scheduler(), luz_callback_metrics(), luz_callback_model_checkpoint(), luz_callback_profile(), luz_callback_progress(), luz_callback_train_valid()

Examples

```
print_callback <- luz_callback(
 name = "print_callback",
 on_train_batch_end = function() {
   cat("Iteration ", ctx$iter, "\n")
 },
 on_epoch_end = function() {
   cat("Done!\n")
 }
)
```

`luz_callback_csv_logger` *CSV logger callback*

Description

Logs metrics obtained during training a fiel on disk. The file will have 1 line for each epoch/validation.

Usage

```
luz_callback_csv_logger(path)
```

Arguments

`path`	path to a file on disk.

See Also

Other luz_callbacks: luz_callback_early_stopping(), luz_callback_interrupt(), luz_callback_lr_scheduler(), luz_callback_metrics(), luz_callback_model_checkpoint(), luz_callback_profile(), luz_callback_progress(), luz_callback_train_valid(), luz_callback()

`luz_callback_early_stopping` *Early stopping callback*

Description

Stops training when a monitored metric stops improving

Usage

```
luz_callback_early_stopping(
  monitor = "valid_loss",
  min_delta = 0,
  patience = 0,
  mode = "min",
  baseline = NULL
)
```

Arguments

`monitor`	A string in the format <set>_<metric> where <set> can be 'train' or 'valid' and <metric> can be the abbreviation of any metric that you are tracking during training. The metric name is case insensitive.
`min_delta`	Minimum improvement to reset the patience counter.
`patience`	Number of epochs without improving until stoping training.
`mode`	Specifies the direction that is considered an improvement. By default 'min' is used. Can also be 'max' (higher is better) and 'zero' (closer to zero is better).
`baseline`	An initial value that will be used as the best seen value in the begining. Model will stopm training if no better than baseline value is found in the first `patience` epochs.

Value

A `luz_callback` that does early stopping.

Note

This callback adds a `on_early_stopping` callback that can be used to call callbacks after as soon as the model stopped training.

If `verbose=TRUE` in `fit.luz_module_generator()` a message is printed when early stopping.

See Also

Other luz_callbacks: `luz_callback_csv_logger()`, `luz_callback_interrupt()`, `luz_callback_lr_scheduler()`, `luz_callback_metrics()`, `luz_callback_model_checkpoint()`, `luz_callback_profile()`, `luz_callback_progress(`
`luz_callback_train_valid()`, `luz_callback()`

Examples

```
cb <- luz_callback_early_stopping()
```

`luz_callback_interrupt` *Interrupt callback*

Description

Adds a handler that allows interrupting the training loop using `ctrl + C`. Also registers a `on_interrupt` breakpoint so users can register callbacks to be run on training loop interruption.

Usage

```
luz_callback_interrupt()
```

Value

A `luz_callback`

Note

In general you don't need to use these callback by yourself because it's always included by default in `fit.luz_module_generator()`.

See Also

Other luz_callbacks: `luz_callback_csv_logger()`, `luz_callback_early_stopping()`, `luz_callback_lr_scheduler()`
`luz_callback_metrics()`, `luz_callback_model_checkpoint()`, `luz_callback_profile()`, `luz_callback_progress()`
`luz_callback_train_valid()`, `luz_callback()`

Examples

```
interrupt_callback <- luz_callback_interrupt()
```

`luz_callback_lr_scheduler` *Learning rate scheduler callback*

Description

Initializes and runs `torch::lr_scheduler()`s.

Usage

```
luz_callback_lr_scheduler(
  lr_scheduler,
  ...,
  call_on = "on_epoch_end",
  opt_name = NULL
)
```

Arguments

`lr_scheduler`	A `torch::lr_scheduler()` that will be initialized with the optimizer and the `...` parameters.
`...`	Additional arguments passed to `lr_scheduler` together with the optimizers.
`call_on`	The callback breakpoint that `scheduler$step()` is called. Default is `'on_epoch_end'`. See `luz_callback()` for more information.
`opt_name`	name of the optimizer that will be affected by this callback. Should match the name given in `set_optimizers`. If your module has a single optimizer, `opt_name` is not used.

Value

A `luz_callback()` generator.

See Also

Other luz_callbacks: `luz_callback_csv_logger()`, `luz_callback_early_stopping()`, `luz_callback_interrupt()`, `luz_callback_metrics()`, `luz_callback_model_checkpoint()`, `luz_callback_profile()`, `luz_callback_progress(`
`luz_callback_train_valid()`, `luz_callback()`

Examples

```
if (torch::torch_is_installed()) {
cb <- luz_callback_lr_scheduler(torch::lr_step, step_size = 30)
}
```

luz_callback_metrics *Metrics callback*

Description

Tracks metrics passed to `setup()` during training and validation.

Usage

```
luz_callback_metrics()
```

Details

This callback takes care of 2 ctx attributes:

- `ctx$metrics`: stores the current metrics objects that are initialized once for epoch, and are further `update()`d and `compute()`d every batch. You will rarely need to work with these metrics.
- `ctx$records$metrics`: Stores metrics per training/validation and epoch. The structure is very similar to `ctx$losses`.

Value

A `luz_callback`

Note

In general you won't need to explicitly use the metrics callback as it's used by default in `fit.luz_module_generator()`.

See Also

Other luz_callbacks: `luz_callback_csv_logger()`, `luz_callback_early_stopping()`, `luz_callback_interrupt()`, `luz_callback_lr_scheduler()`, `luz_callback_model_checkpoint()`, `luz_callback_profile()`, `luz_callback_progress()`, `luz_callback_train_valid()`, `luz_callback()`

luz_callback_model_checkpoint *Checkpoints model weights*

Description

This saves checkpoints of the model according to the specified metric and behavior.

Usage

```
luz_callback_model_checkpoint(
  path,
  monitor = "valid_loss",
  save_best_only = FALSE,
  mode = "min",
  min_delta = 0
)
```

Arguments

path	Path to save the model on disk. The path is interpolated with glue, so you can use any attribute within the ctx by using '{ctx$epoch}'. Specially the epoch and monitor quantities are already in the environment. If the specified path is a path to a directory (ends with / or \), then models are saved with the name given by epoch-{epoch:02d}-{self$monitor}-{monitor:.3f}.pt. See more in the examples. You can use sprintf() to quickly format quantities, for example:'{epoch:02d}'.
monitor	A string in the format <set>_<metric> where <set> can be 'train' or 'valid' and <metric> can be the abbreviation of any metric that you are tracking during training. The metric name is case insensitive.
save_best_only	if TRUE models are only saved if they have an improvement over a previously saved model.
mode	Specifies the direction that is considered an improvement. By default 'min' is used. Can also be 'max' (higher is better) and 'zero' (closer to zero is better).
min_delta	Minimum difference to consider as improvement. Only used when save_best_only=TRUE.

Note

mode and min_delta are only used when save_best_only=TRUE. save_best_only will overwrite the saved models if the path parameter don't differentiate by epochs.

See Also

Other luz_callbacks: luz_callback_csv_logger(), luz_callback_early_stopping(), luz_callback_interrupt(), luz_callback_lr_scheduler(), luz_callback_metrics(), luz_callback_profile(), luz_callback_progress(), luz_callback_train_valid(), luz_callback()

Examples

```
luz_callback_model_checkpoint(path= "path/to/dir")
luz_callback_model_checkpoint(path= "path/to/dir/epoch-{epoch:02d}/model.pt")
luz_callback_model_checkpoint(path= "path/to/dir/epoch-{epoch:02d}/model-{monitor:.2f}.pt")
```

`luz_callback_profile` *Profile callback*

Description

Computes the times for high-level operations in the training loops.

Usage

```
luz_callback_profile()
```

Details

Records are saved in `ctx$records$profile`. Times are stored as seconds. Data is stored in the following structure:

- **fit** time for the entire fit procedure.
- **epoch** times per epoch
- **(train/valid)_batch** time per batch of data processed, including data acquisition and step.
- **(train/valid)_step** time per step (training or validation step) - only the model step. (not including data acquisition and preprocessing)

Value

A `luz_callback`

Note

In general you don't need to use these callback by yourself because it's always included by default in `fit.luz_module_generator()`.

See Also

Other luz_callbacks: `luz_callback_csv_logger()`, `luz_callback_early_stopping()`, `luz_callback_interrupt()`, `luz_callback_lr_scheduler()`, `luz_callback_metrics()`, `luz_callback_model_checkpoint()`, `luz_callback_progress()`, `luz_callback_train_valid()`, `luz_callback()`

Examples

```
profile_callback <- luz_callback_profile()
```

luz_callback_progress *Progress callback*

Description

Responsible for printing progress during training.

Usage

```
luz_callback_progress()
```

Value

A luz_callback

Note

In general you don't need to use these callback by yourself because it's always included by default in `fit.luz_module_generator()`.

Printing can be disabled by passing `verbose=FALSE` to `fit.luz_module_generator()`.

See Also

Other luz_callbacks: `luz_callback_csv_logger()`, `luz_callback_early_stopping()`, `luz_callback_interrupt()`, `luz_callback_lr_scheduler()`, `luz_callback_metrics()`, `luz_callback_model_checkpoint()`, `luz_callback_profile()`, `luz_callback_train_valid()`, `luz_callback()`

luz_callback_train_valid *Train-eval callback*

Description

Switches important flags for training and evaluation modes.

Usage

```
luz_callback_train_valid()
```

Details

It takes care of the three `ctx` attributes:

- `ctx$model`: Responsible for calling `ctx$model$train()` and `ctx$model$eval()`, when appropriate.
- `ctx$training`: Sets this flag to `TRUE` when training and `FALSE` when in validation mode.
- `ctx$loss`: Resets the `loss` attribute to `list()` when finished training/ or validating.

Value

A luz_callback

Note

In general you won't need to explicitly use the metrics callback as it's used by default in fit.luz_module_generator().

See Also

Other luz_callbacks: luz_callback_csv_logger(), luz_callback_early_stopping(), luz_callback_interrupt(), luz_callback_lr_scheduler(), luz_callback_metrics(), luz_callback_model_checkpoint(), luz_callback_profile(), luz_callback_progress(), luz_callback()

---

luz_load *Load trained model*

Description

Loads a fitted model. See documentation in luz_save().

Usage

```
luz_load(path)
```

Arguments

path	path in file system so save the object.

See Also

Other luz_save: luz_save()

---

luz_load_model_weights *Loads model weights into a fitted object.*

Description

This can be useful when you have saved model checkpoints during training and want to reload the best checkpoint in the end.

Usage

```
luz_load_model_weights(obj, path, ...)

luz_save_model_weights(obj, path)
```

Arguments

obj	luz object to which you want to copy the new weights.
path	path to saved model in disk.
...	other arguments passed to torch_load().

Value

Returns NULL invisibly.

Warning

luz_save_model_weights operates inplace, ie modifies the model object to contain the new weights.

---

luz_metric *Creates a new luz metric*

Description

Creates a new luz metric

Usage

```
luz_metric(
  name = NULL,
  ...,
  private = NULL,
  active = NULL,
  parent_env = parent.frame(),
  inherit = NULL
)
```

Arguments

name	string naming the new metric.
...	named list of public methods. You should implement at least initialize, update and compute. See the details section for more information.
private	An optional list of private members, which can be functions and non-functions.
active	An optional list of active binding functions.
parent_env	An environment to use as the parent of newly-created objects.
inherit	A R6ClassGenerator object to inherit from; in other words, a superclass. This is captured as an unevaluated expression which is evaluated in parent_env each time an object is instantiated.

Details

In order to implement a new `luz_metric` we need to implement 3 methods:

- `initialize`: defines the metric initial state. This function is called for each epoch for both training and validation loops.
- `update`: updates the metric internal state. This function is called at every training and validation step with the predictions obtained by the model and the target values obtained from the dataloader.
- `compute`: uses the internal state to compute metric values. This function is called whenever we need to obtain the current metric value. Eg, it's called every training step for metrics displayed in the progress bar, but only called once per epoch to record it's value when the progress bar is not displayed.

Optionally, you can implement a `abbrev` field that gives the metric an abbreviation that will be used when displaying metric information in the console or tracking record. If no `abbrev` is passed, the class name will be used.

Let's take a look at the implementation of `luz_metric_accuracy` so you can see how to implement a new one:

```
luz_metric_accuracy <- luz_metric(
  # An abbreviation to be shown in progress bars, or
  # when printing progress
  abbrev = "Acc",
  # Initial setup for the metric. Metrics are initialized
  # every epoch, for both training and validation
  initialize = function() {
    self$correct <- 0
    self$total <- 0
  },
  # Run at every training or validation step and updates
  # the internal state. The update function takes `preds`
  # and `target` as parameters.
  update = function(preds, target) {
    pred <- torch::torch_argmax(preds, dim = 2)
    self$correct <- self$correct + (pred == target)$
      to(dtype = torch::torch_float())$
      sum()$
      item()
    self$total <- self$total + pred$numel()
  },
  # Use the internal state to query the metric value
  compute = function() {
    self$correct/self$total
  }
)
```

Note: It's good practice that the `compute` metric returns regular R values instead of torch tensors and other parts of luz will expect that.

Value

Returns new Luz metric.

See Also

Other luz_metrics: luz_metric_accuracy(), luz_metric_binary_accuracy_with_logits(), luz_metric_binary_accuracy(), luz_metric_binary_auroc(), luz_metric_mae(), luz_metric_mse(), luz_metric_multiclass_auroc(), luz_metric_rmse()

Examples

```
luz_metric_accuracy <- luz_metric(
  # An abbreviation to be shown in progress bars, or
  # when printing progress
  abbrev = "Acc",
  # Initial setup for the metric. Metrics are initialized
  # every epoch, for both training and validation
  initialize = function() {
    self$correct <- 0
    self$total <- 0
  },
  # Run at every training or validation step and updates
  # the internal state. The update function takes `preds`
  # and `target` as parameters.
  update = function(preds, target) {
    pred <- torch::torch_argmax(preds, dim = 2)
    self$correct <- self$correct + (pred == target)$
      to(dtype = torch::torch_float())$
      sum()$
      item()
    self$total <- self$total + pred$numel()
  },
  # Use the internal state to query the metric value
  compute = function() {
    self$correct/self$total
  }
)
```

---

luz_metric_accuracy *Accuracy*

Description

Computes accuracy for multi-class classification problems.

Usage

```
luz_metric_accuracy()
```

Details

This metric expects to take logits or probabilities at every update. It will then take the columnwise argmax and compare to the target.

Value

Returns new Luz metric.

See Also

Other luz_metrics: `luz_metric_binary_accuracy_with_logits()`, `luz_metric_binary_accuracy()`, `luz_metric_binary_auroc()`, `luz_metric_mae()`, `luz_metric_mse()`, `luz_metric_multiclass_auroc()`, `luz_metric_rmse()`, `luz_metric()`

Examples

```
if (torch::torch_is_installed()) {
library(torch)
metric <- luz_metric_accuracy()
metric <- metric$new()
metric$update(torch_randn(100, 10), torch::torch_randint(1, 10, size = 100))
metric$compute()
}
```

---

luz_metric_binary_accuracy

Binary accuracy

Description

Computes the accuracy for binary classification problems where the model returns probabilities. Commonly used when the loss is `torch::nn_bce_loss()`.

Usage

```
luz_metric_binary_accuracy(threshold = 0.5)
```

Arguments

`threshold`	value used to classifiy observations between 0 and 1.

Value

Returns new Luz metric.

See Also

Other luz_metrics: luz_metric_accuracy(), luz_metric_binary_accuracy_with_logits(), luz_metric_binary_auroc(), luz_metric_mae(), luz_metric_mse(), luz_metric_multiclass_auroc(), luz_metric_rmse(), luz_metric()

Examples

```
if (torch::torch_is_installed()) {
library(torch)
metric <- luz_metric_binary_accuracy(threshold = 0.5)
metric <- metric$new()
metric$update(torch_rand(100), torch::torch_randint(0, 1, size = 100))
metric$compute()
}
```

---

luz_metric_binary_accuracy_with_logits

Binary accuracy with logits

Description

Computes accuracy for binary classification problems where the model return logits. Commonly used together with torch::nn_bce_with_logits_loss().

Usage

```
luz_metric_binary_accuracy_with_logits(threshold = 0.5)
```

Arguments

threshold	value used to classifiy observations between 0 and 1.

Details

Probabilities are generated using torch::nnf_sigmoid() and threshold is used to classify between 0 or 1.

Value

Returns new Luz metric.

See Also

Other luz_metrics: luz_metric_accuracy(), luz_metric_binary_accuracy(), luz_metric_binary_auroc(), luz_metric_mae(), luz_metric_mse(), luz_metric_multiclass_auroc(), luz_metric_rmse(), luz_metric()

Examples

```
if (torch::torch_is_installed()) {
library(torch)
metric <- luz_metric_binary_accuracy_with_logits(threshold = 0.5)
metric <- metric$new()
metric$update(torch_randn(100), torch::torch_randint(0, 1, size = 100))
metric$compute()
}
```

`luz_metric_binary_auroc` *Computes the area under the ROC*

Description

To avoid storing all predictions and targets for an epoch we compute confusion matrices across a range of pre-established thresholds.

Usage

```
luz_metric_binary_auroc(
  num_thresholds = 200,
  thresholds = NULL,
  from_logits = FALSE
)
```

Arguments

`num_thresholds`	Number of thresholds used to compute confusion matrices. In that case, thresholds are created by getting `num_thresholds` values linearly spaced in the unit interval.
`thresholds`	(optional) If threshold are passed, then those are used to compute the confusion matrices and `num_thresholds` is ignored.
`from_logits`	Boolean indicating if predictions are logits, in that case we use sigmoid to put them in the unit interval.

See Also

Other luz_metrics: `luz_metric_accuracy()`, `luz_metric_binary_accuracy_with_logits()`, `luz_metric_binary_accuracy()`, `luz_metric_mae()`, `luz_metric_mse()`, `luz_metric_multiclass_auroc()`, `luz_metric_rmse()`, `luz_metric()`

Examples

```
if (torch::torch_is_installed()){
library(torch)
actual <- c(1, 1, 1, 0, 0, 0)
predicted <- c(0.9, 0.8, 0.4, 0.5, 0.3, 0.2)

y_true <- torch_tensor(actual)
y_pred <- torch_tensor(predicted)

m <- luz_metric_binary_auroc(thresholds = predicted)
m <- m$new()

m$update(y_pred[1:2], y_true[1:2])
m$update(y_pred[3:4], y_true[3:4])
m$update(y_pred[5:6], y_true[5:6])

m$compute()
}
```

---

luz_metric_mae *Mean absolute error*

Description

Computes the mean absolute error.

Usage

```
luz_metric_mae()
```

Value

Returns new Luz metric.

See Also

Other luz_metrics: luz_metric_accuracy(), luz_metric_binary_accuracy_with_logits(), luz_metric_binary_accuracy(), luz_metric_binary_auroc(), luz_metric_mse(), luz_metric_multiclass_auroc(luz_metric_rmse(), luz_metric()

Examples

```
if (torch::torch_is_installed()) {
library(torch)
metric <- luz_metric_mae()
metric <- metric$new()
metric$update(torch_randn(100), torch_randn(100))
metric$compute()
}
```

luz_metric_mse *Mean squared error*

Description

Computes the mean squared error

Usage

```
luz_metric_mse()
```

Value

A luz_metric object.

See Also

Other luz_metrics: `luz_metric_accuracy()`, `luz_metric_binary_accuracy_with_logits()`, `luz_metric_binary_accuracy()`, `luz_metric_binary_auroc()`, `luz_metric_mae()`, `luz_metric_multiclass_auroc()`, `luz_metric_rmse()`, `luz_metric()`

luz_metric_multiclass_auroc *Computes the multi-class AUROC*

Description

The same definition as Keras is used by default. This is equivalent to the `'micro'` method in SciKit Learn too. See docs.

Usage

```
luz_metric_multiclass_auroc(
  num_thresholds = 200,
  thresholds = NULL,
  from_logits = FALSE,
  average = c("micro", "macro", "weighted", "none")
)
```

Arguments

num_thresholds	Number of thresholds used to compute confusion matrices. In that case, thresholds are created by getting num_thresholds values linearly spaced in the unit interval.
thresholds	(optional) If threshold are passed, then those are used to compute the confusion matrices and num_thresholds is ignored.
from_logits	If TRUE then we call torch::nnf_softmax() in the predictions before computing the metric.
average	The averaging method: • 'micro': Stack all classes and computes the AUROC as if it was a binary classification problem. • 'macro': Finds the AUCROC for each class and computes their mean. • 'weighted': Finds the AUROC for each class and computes their weighted mean pondering by the number of instances for each class. • 'none': Returns the AUROC for each class in a list.

Details

Note that class imbalance can affect this metric unlike the AUC for binary classification.

Currently the AUC is approximated using the 'interpolation' method described in Keras.

See Also

Other luz_metrics: luz_metric_accuracy(), luz_metric_binary_accuracy_with_logits(), luz_metric_binary_accuracy(), luz_metric_binary_auroc(), luz_metric_mae(), luz_metric_mse(), luz_metric_rmse(), luz_metric()

Examples

```
if (torch::torch_is_installed()) {
library(torch)
actual <- c(1, 1, 1, 0, 0, 0) + 1L
predicted <- c(0.9, 0.8, 0.4, 0.5, 0.3, 0.2)
predicted <- cbind(1-predicted, predicted)

y_true <- torch_tensor(as.integer(actual))
y_pred <- torch_tensor(predicted)

m <- luz_metric_multiclass_auroc(thresholds = as.numeric(predicted),
                                 average = "micro")
m <- m$new()

m$update(y_pred[1:2,], y_true[1:2])
m$update(y_pred[3:4,], y_true[3:4])
m$update(y_pred[5:6,], y_true[5:6])
m$compute()
}
```

luz_metric_rmse *Root mean squared error*

Description

Computes the root mean squared error.

Usage

```
luz_metric_rmse()
```

Value

Returns new Luz metric.

See Also

Other luz_metrics: `luz_metric_accuracy()`, `luz_metric_binary_accuracy_with_logits()`, `luz_metric_binary_accuracy()`, `luz_metric_binary_auroc()`, `luz_metric_mae()`, `luz_metric_mse()`, `luz_metric_multiclass_auroc()`, `luz_metric()`

luz_save *Saves luz objects to disk*

Description

Allows saving luz fitted models to the disk. Objects can be loaded back with `luz_load()`.

Usage

```
luz_save(obj, path, ...)
```

Arguments

`obj`	an object of class 'luz_module_fitted' as returned by `fit.luz_module_generator()`.
`path`	path in file system so save the object.
`...`	currently unused.

Warning

The ctx is naively serialized. Ie, we only use `saveRDS()` to serialize it. Don't expect `luz_save` to work correctly if you have unserializable objects in the ctx like `torch_tensors` and external pointers in general.

Note

Objects are saved as plain `.rds` files but `obj$model` is serialized with `torch_save` before saving it.

See Also

Other luz_save: `luz_load()`

`setup` *Set's up a* `nn_module` *to use with luz*

Description

The setup function is used to set important attributes and method for `nn_modules` to be used with Luz.

Usage

```
setup(module, loss = NULL, optimizer = NULL, metrics = NULL)
```

Arguments

`module`	(`nn_module`) The `nn_module` that you want set up.
`loss`	(`function`, optional) An optional function with the signature function(input, target). It's only requires if your `nn_module` doesn't implement a method called `loss`.
`optimizer`	(`torch_optimizer`, optional) A function with the signature function(parameters, ...) that is used to initialize an optimizer given the model parameters.
`metrics`	(`list`, optional) A list of metrics to be tracked during the training procedure.

Details

It makes sure the module have all the necessary ingredients in order to be fitted.

Value

A luz module that can be trained with `fit()`.

set_hparams *Set hyper-parameter of a module*

Description

This function is used to define hyper-parameters before calling `fit` for `luz_modules`.

Usage

```
set_hparams(module, ...)
```

Arguments

`module`	An `nn_module` that has been `setup()`.
`...`	The parameters set here will be used to initialize the `nn_module`, ie they are passed unchanged to the `initialize` method of the base `nn_module`.

Value

The same luz module

See Also

Other set_hparam: `set_opt_hparams()`

set_opt_hparams *Set optimizer hyper-parameters*

Description

This function is used to define hyper-parameters for the optimizer initialization method.

Usage

```
set_opt_hparams(module, ...)
```

Arguments

`module`	An `nn_module` that has been `setup()`.
`...`	The parameters passed here will be used to initialize the optimizers. For example, if your optimizer is `optim_adam` and you pass `lr=0.1`, then the `optim_adam` function is called with `optim_adam(parameters,lr=0.1)` when fitting the model.

Value

The same luz module

See Also

Other set_hparam: `set_hparams()`

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