Modeling Context in Referring Expression

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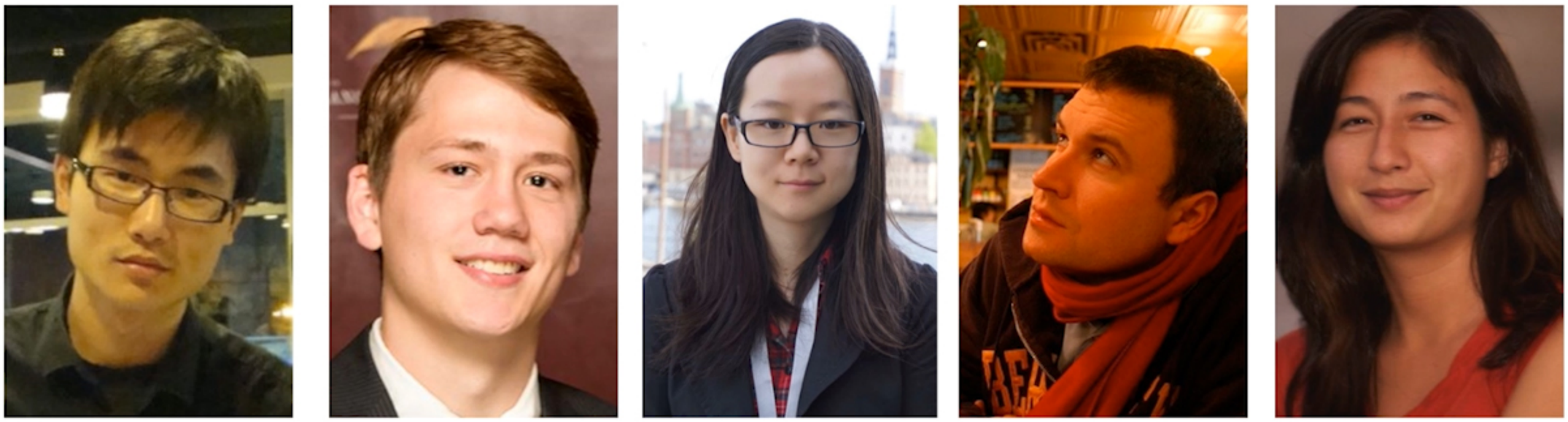

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Referring Expression

Referring Expression Game

woman washing dishes

ReferIt Game, EMNLP2014

Referring Expression Game

woman washing dishes

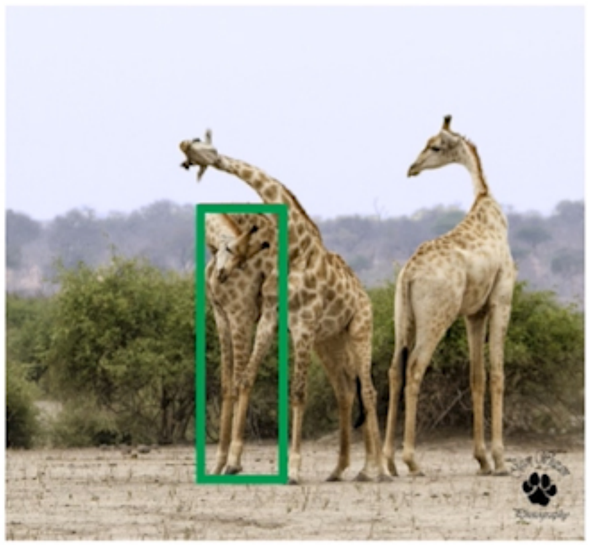
ReferIt Game, EMNLP2014

Datasets

- **RefCOCO** UNC
  - 142210 referring expressions for 50000 objects in 19994 images
- **RefCOCO+** UNC
  - 141564 referring expressions for 49856 objects in 19992 images
- **RefCOCOg** Google
  - 104560 referring expressions for 54822 objects in 26711 images

UNC's datasets are available at https://github.com/lichengunc/refer

Difference between three datasets



RefCOCO: giraffe on the left

RefCOCO+: giraffe with lowered head down

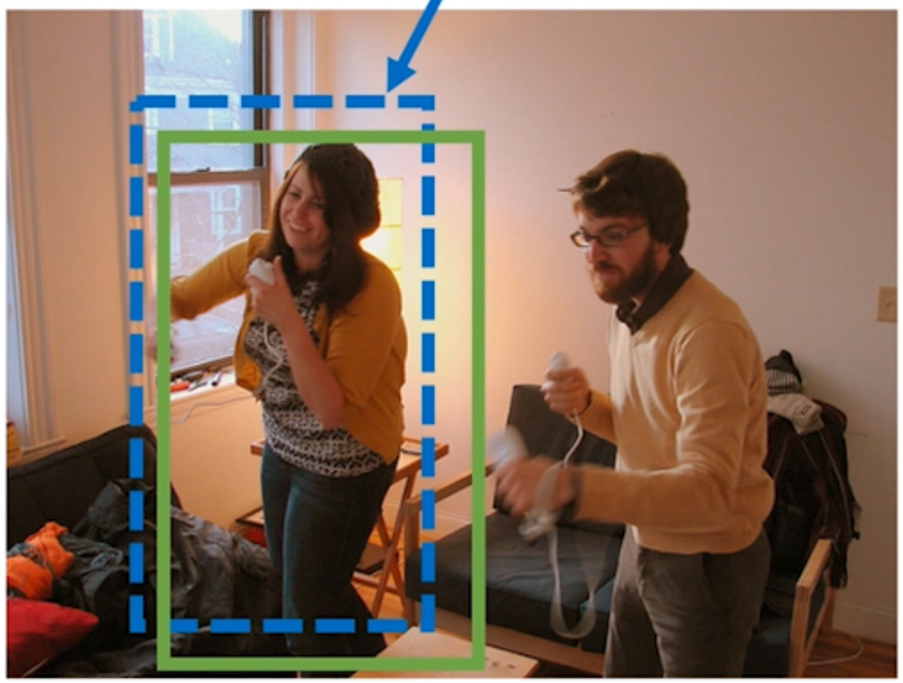
RefCOCOg: an adult giraffe scratching its back with its horn

Dataset	Collection way	Expression Style	Allow location words
RefCOCO (UNC)	Interactive Game	Free style	yes
RefCOCO+ (UNC)	Interactive Game	Free style	no
RefCOCOg (Google)	Non-interactive	COCO-caption style	yes

Two tasks

Task 1: comprehension

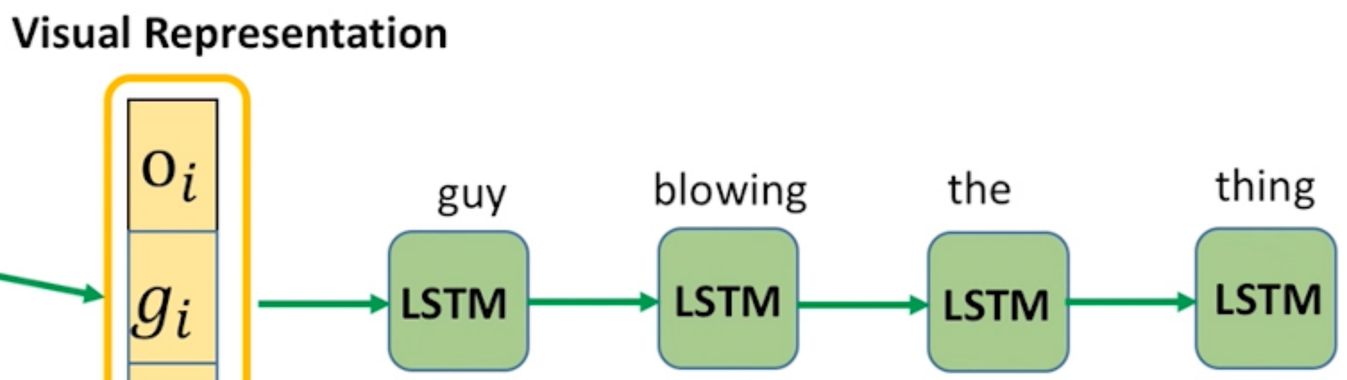
Which object is "**Girl on the left**" indicating?



Task 2: Expression Generation

Generate referring expression for this target person.

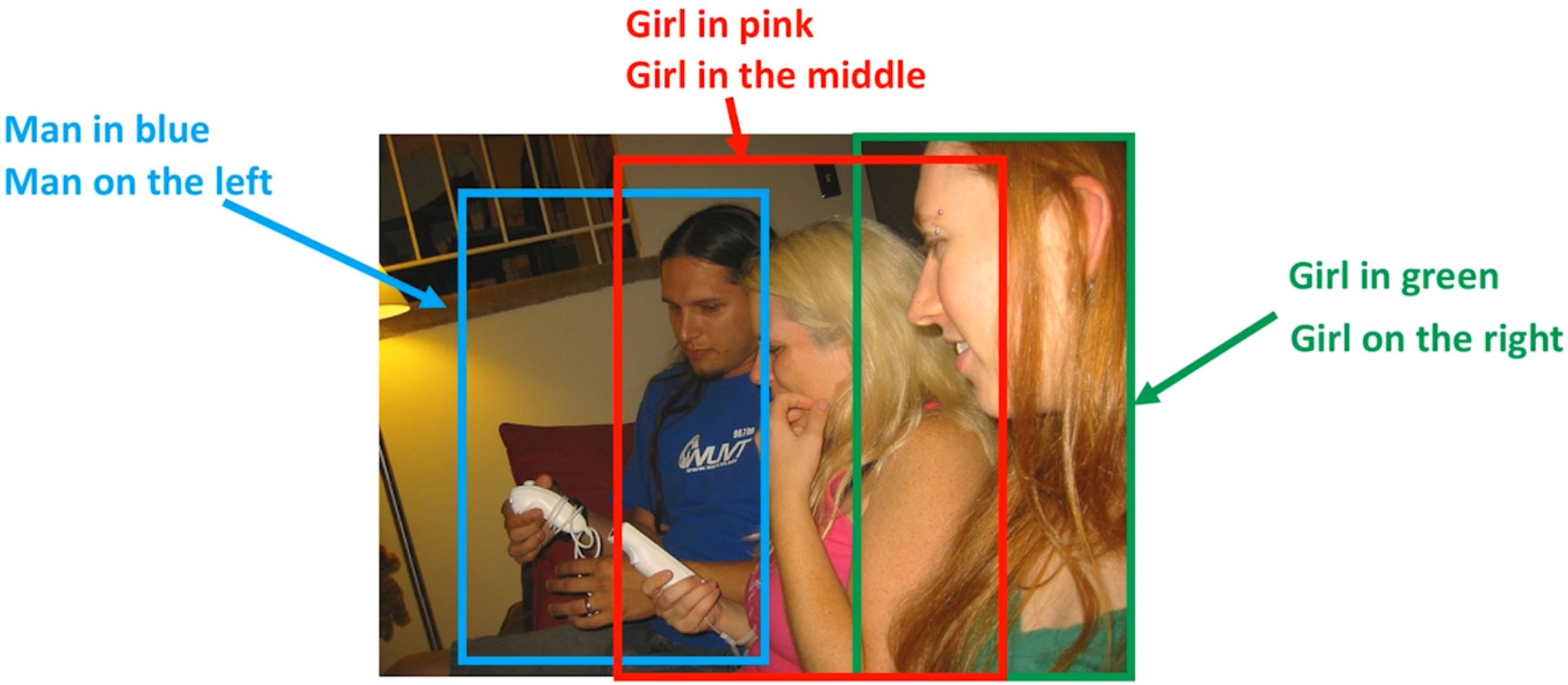
Baseline model



$$(o_i, g_i, l_i) = \left(\text{CNN}, \text{CNN}, [\frac{x_{tl}}{W}, \frac{y_{tl}}{H}, \frac{x_{br}}{w}, \frac{y_{br}}{H}, \frac{w \cdot h}{W \cdot H}] \right)$$

Generation and Comprehension of Unambiguous Object Descriptions, CVPR2016

Our model: visual comparison

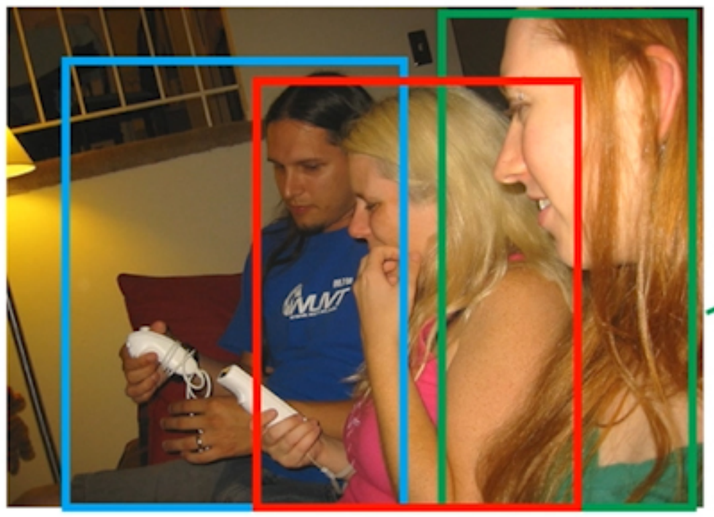


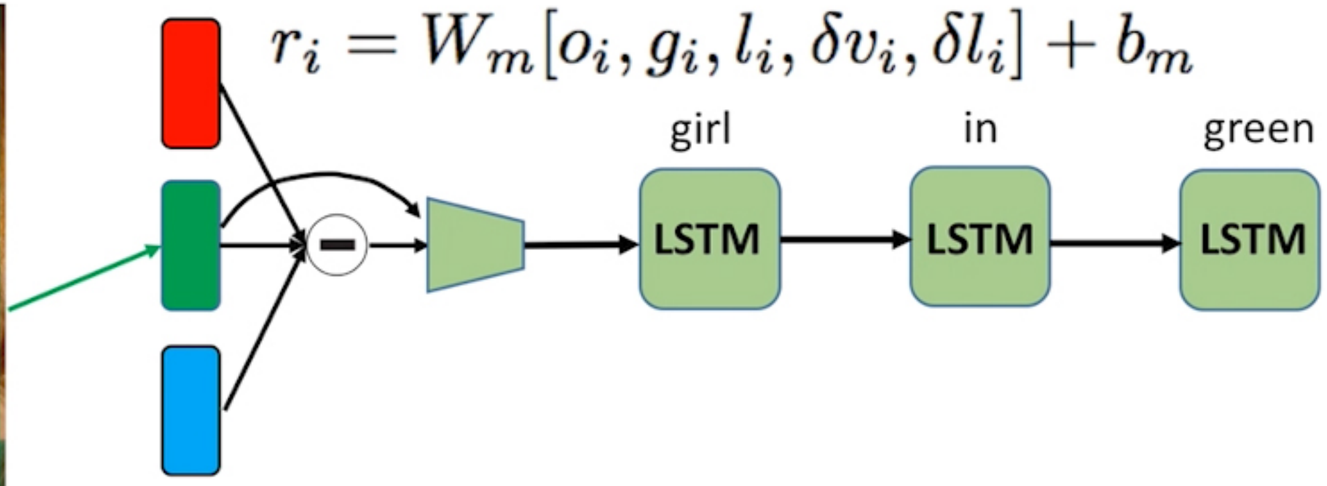
Visual Comparison

- Object comparisons are critical for producing unambiguous referring expression

$$\delta v_i = \frac{1}{n}\sum_{j\neq i}\frac{o_i - o_j}{\|o_i - o_j\|}$$

$$\delta l_{ij} = [\frac{[\triangle x_{tl}]_{ij}}{w_i}, \frac{[\triangle y_{tl}]_{ij}}{h_i}, \frac{[\triangle x_{br}]_{ij}}{w_i}, \frac{[\triangle y_{br}]_{ij}}{h_i}, \frac{w_j h_j}{w_i h_i}]$$



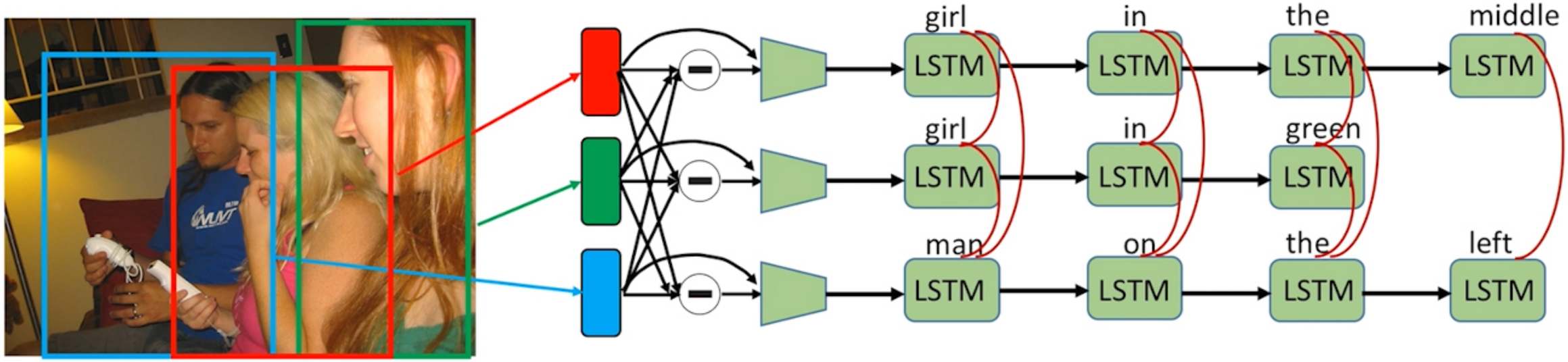


Language Tying

- Tying language generation together by adding the connections between expressions.

$$h_{dif_{i_t}} = \frac{1}{n} \sum_{j \neq i} \frac{h_{i_t} - h_{j_t}}{\|h_{i_t} - h_{j_t}\|}$$

$$P(w_{i_t} | w_{i_{t-1}}, ..., w_{i_1}, v_i, \{h_{j_t, j \neq i}\}) = \text{softmax}(W_h[h_{i_t}, h_{dif_{i_t}}] + b_h)$$



Task1: Comprehension

	RefCOCO		RefCOCO+		RefCOCOg
	Test A	Test B	Test A	Test B	Validation
Baseline[22]	63.15%	64.21%	48.73%	42.13%	55.16%
visdif	67.57%	71.19%	52.44%	47.51%	59.25%
MMI[22]	71.72%	71.09%	58.42%	51.23%	62.14%
visdif+MMI	**73.98%**	**76.59%**	**59.17%**	**55.62%**	**64.02%**

Task2: Generation

RefCOCO

	Test A				Test B			
	Bleu 1	Bleu 2	Rouge	Meteor	Bleu 1	Bleu 2	Rouge	Meteor
Baseline [22]	0.477	0.290	0.413	0.173	0.553	0.343	0.499	0.228
MMI [22]	0.478	0.295	0.418	0.175	0.547	0.341	0.497	0.228
visdif	0.505	**0.322**	0.441	0.184	0.583	0.382	0.530	0.245
visdif+MMI	0.494	0.307	0.441	0.185	0.578	0.375	0.531	0.247
Baseline+tie	0.490	0.308	0.431	0.181	0.561	0.352	0.505	0.234
visdif+tie	**0.510**	0.318	**0.446**	**0.189**	**0.593**	**0.386**	**0.533**	**0.249**
visdif+MMI+tie	0.506	0.312	0.445	0.188	0.579	0.370	0.525	0.246

RefCOCO+

	Test A				Test B			
	Bleu 1	Bleu 2	Rouge	Meteor	Bleu 1	Bleu 2	Rouge	Meteor
Baseline [22]	0.391	0.218	0.356	0.140	0.331	0.174	0.322	0.135
MMI [22]	0.370	0.203	0.346	0.136	0.324	0.167	0.320	0.133
visdif	0.407	0.235	0.363	0.145	0.339	0.177	0.325	0.145
visdif+MMI	0.386	0.221	0.360	0.142	0.327	0.172	0.325	0.135
Baseline+tie	0.392	0.219	0.361	0.143	0.336	0.177	0.325	0.140
visdif+tie	**0.409**	**0.232**	**0.372**	**0.150**	**0.340**	**0.178**	**0.328**	**0.143**
visdif+MMI+tie	0.393	0.220	0.360	0.142	0.327	0.175	0.321	0.137

RefCOCO

Ground-truth
Prediction

RefCOCO+

guy in white on far right

blurry person
with sleeveless and sitting

RefCOCO

head on left

woman in middle

person on right

RefCOCO+

closest sheep

sheep behind other sheep

Thank you!

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